Art as a Distributed Ecosystem: mapping the limits of systems-based art

P GOODFELLOW

PHD

2018

Art as a Distributed Ecosystem: mapping the limits of systems-based art

PAUL GOODFELLOW

A thesis submitted in partial fulfillment of the requirements of the University of Northumbria at Newcastle for the degree of Doctor of Philosophy

Research undertaken in the Faculty of Arts, Design and Social Sciences

February 2018

Abstract

My practice-based fine art research is shaped and informed by my transdisciplinary background and specifically my experience of ecology, geography and data visualisation. As a result I draw on the concepts of the 'ecosystem' and the 'information system' to consider how an artwork can be understood in ecological and informational terms, especially in relation to my own engagement with 'Systems Art', a mode of practice which shares a systems thinking foundation with these concepts.

This research identifies three periods of systems thinking influencing culture, and this understanding has helped structure the thesis. Firstly, the holistic ecology movements of the mid-1960s which generated expanded expectations of the term ‘system’, secondly, the shift towards the ‘informational’ inherent in the critiques of linguistic and institutional systems of the 1980s, finally, our current ‘post-systems’ condition in which the pervading and infinitely complex nature of socio-environmental systems and their simulation is acknowledged.

This three-fold journey is marked by incremental modifications to the definition of a system as the idea takes on greater extension through Latour's Actor-Network Theory and Deleuze and Guattari's Assemblage Theory. Later, the incomprehensibility of complex systems is conjured through references to Timothy Morton's concept of the Hyperobject and Object-Oriented Ontology's notion of ‘withdrawal'.

The practical component of my research is a body of artwork, which is a product of my engagement with systems thinking, the natural environment, complex information, image processing and painting. Within the material production of two and three-dimensional artworks, the perspective I have gained is that of a researcher exploring the analogical potential of an extensively ‘distributed ecosystem'. If this perspective is persuasive, then artists interested in systems should be encouraged to not only map more expansive and complex boundaries for their work, but also articulate the unknowability of these complex systems as a knowable dimension of the distributed meaning of ‘Systems Art’.

Contents

List of figures

Figures for appendices

Acknowledgements

I would like to thank the staff and fellow PhD students at Northumbria University, for creating an engaging and supportive community. My practice is transdisciplinary and I am grateful for the support and advice I have received during my research from staff beyond the boundaries of Fine Art, in particular from the Department of Design. I am also grateful to the artist James Hugonin for invaluable studio conversations.

I would particularly like to thank Professor Chris Dorsett, for his understanding and support of the Fine Art practice-based research process. His experience and engagement has helped me unfold my practice at a deeper level, whilst allowing the work to retain its essential nature.

I am also thankful for the ecologists and geographers I have worked with in the past. I am particularly indebted to Simon Aspinall and his positive and embodied engagement with nature. I would like to thank my friends and family for support and understanding during this complex, but rewarding process, with special thanks to Birgitta, Maisie and Brodie.

Declaration

I declare that the work contained in this thesis has not been submitted for any other award and that it is all my own work. The procedures for ethical approval were followed and I confirm that this work fully acknowledges opinions, ideas and contributions from the works of others.

I declare that the word count of this thesis is 43,142

Name: Paul Goodfellow

Signature:

Unfolding

Introduction: Unfolding

I am interested in how contemporary artists can probe and outreach the most expanded and complicated borders of systems-based practice in art. For me, this is primarily a problem of making coherent discoveries about the workings of highly ‘distributed' entities that are recognisably the product of a system whilst simultaneously respecting the incomprehensibility of the largest imaginable structures. This task has to be transdisciplinary because first-hand encounters with the porosity of disciplinary boundaries are the only way of appreciating the unknowable reach of unfolding events as they form what Deleuze and Guattari call the ‘plane of immanence', to my mind the perfect image of a truly expansive system. Thus, I have not only found myself drawing from art history and philosophy to historize and ground my engagement with Systems Art, but also had to utilise, and then reflect upon, conceptual models and markers in Systems Thinking as it occurs in Ecology, Geography and Information Science. This transdisciplinarity is powerfully encapsulated in Levi-Strauss' characterisation of the ‘bricoleur': that is, someone who is ‘adept at performing a large number of diverse tasks' (Levi-Strauss, 1968, p. 17). This celebrated and influential image represents a handyman who can collect ‘elements,' that is, methods and knowledge, from a diverse range of fields for future appropriation. Levi-Strauss suggested that these

> ‘elements are collected and retained on the principle that 'they may always come in handy.' Such elements are specialised up to a point, sufficiently for the 'bricoleur' not to need the equipment and knowledge of all trades and professions, but not enough for each of them to have one definite and determinate use. They each represent a set of actual and possible relations; they are 'operators, ' but they can be used for any operations of the same type.' (1968, p17)

This image captures the method I have employed from the beginning of my research. I identified with the modus operandi and mind-set of a bricoleur as I sketched out my initial research questions (e.g. If the contemporary art object is dynamic and distributed across a range of materials and processes, how can an artist understand and mediate the flows of material, information and messages through the work?) and set the targets for my doctoral project (e.g. demonstrate that a model of an ecosystem is comparable to a model of a complex systems artwork). Furthermore, the bricoleur in me knew that a practice-based investigation should unfold, as artworks are created, as an informationally rich environment within which unexpected experiences are continually emerging and disappearing.

Thus, the challenge that preoccupied me as I planned my PhD was that both my theoretical and my practical research would have to operate as open fields. However, I also would have to articulate a clear path through these expanded spaces to offer access to the actual complexity of the topic for the reader. As inter-related research themes, ‘systems' and ‘artworks' can both be understood as morphologically nonlinear and open; consequently, writing up my project as a definitive thesis was always going to complicate my dedication to the bricoleur's ‘diverse tasks'. As my project proceeded I began to speculate about the tension between the systems theorist’s description of the world and the artist's material engagement with the experienced world. I noticed that as the former increased in complexity, it moved from being a description of the subject to being a simulation of the subject. Thus, I modified my quest to addressing how contemporary art objects, in becoming dynamic and distributed across a range of materials and processes, became simulacra uncoupled from a process of production and critical reflection. In this way, my bricoleur sensibility increasingly gained insights into the incomprehensibility of extensively distributed systems. As a result, this thesis has been structured as a journey to reflect my step-by-step path through the complex and ambiguous bricolage of systems thinking. The journey opens out along three folds to reveal, in a framework of ideas derived from the work of the media theorist Laura Marks, how the most expanded and complicated structures one can (just about) bring to mind have driven and informed my research and practice. (Vernallis, Herzog, & Richardson, 2015)

Fold I (Chapters 1-2)

The first fold introduces the topics that motivated my initial PhD plans. I describe where they are located in time and space, and the quest or problems they involved as my research began to open out and expand. This breaks down as follows:

Chapter 1 briefly introduces the transdisciplinary nature of my background and the origins of my systems approach. The problems and challenges of understanding the structure of a complex artwork are introduced, and the concepts of the ‘ecosystem' and ‘information flow' are introduced as possible solutions. The structure of the thesis is established as a personal journey, whilst a broader theoretical implication of the ‘fold' is foreshadowed.

Chapter 2 introduces the concept of the ecosystem as a potential model to describe the artwork in both metaphorical and morphological terms. This draws from my past experiences and the wider holistic philosophy underpinning the ecosystem model is invoked, such as the concept of deep ecology.

Fold II (Chapters 3-4)

The second fold spreads out the premises established in the first fold to demonstrate how these ideas must not be allowed to have one definite and determinate use if the research project is to move on.

Chapter 3 introduces the concept of Information flow, which is also drawn directly from my past experiences. This chapter considers the shift in focus from the material world to the information world, and how we are moving towards simulated reality. Like the 'ecosystem' the model of the information system is employed as a way of describing the internal and external operations of the artwork, without resorting to the dominant art-historical narratives of Systems Art, which would prematurely lock down the outward reaching flow of my journey.

Chapter 4 considers the development of Systems Art, as a movement, and how this can be understood concerning the concurrent waves of cybernetics and environmental awareness. These developments are synthesised together and described as three system folds that have enveloped culture over the past fifty years.

Fold III (Chapter 5-6)

This concept of the temporal folds allows the discussion of systems to expand beyond the environmental and informational roots and incorporate more flexible system descriptions, which have evolved within the Humanities. Thus, chapter 5 extends the model of the system to describe the art object through the introduction of 'Actor-Network Theory', and 'Assemblage Theory'.

The third fold cannot help but play a climatic role in the thesis as it opens out and to a degree, covers over my earlier discussions and debates. Thus, the final chapter

allows the underlying tension between a systems description of the world and my practical experiences to unfold beyond the porous disciplinary barriers I have journeyed across. Here I respond to the ‘systems paradox' in the most expanded state I can imagine. This paradox states that as the system description increases in complexity, it moves from being a description of the subject to being a simulation, and this simulation will, in turn, become simulacra uncoupled from the original subject. Thus, whilst these system thinking tools help probe the boundaries and complexities of the systems artwork they also articulate the unknowability that lies beyond the bounded definitions of a complex system. This is the creative position I have sought throughout my practice-based research.

Withdrawn Fold

These three folds are supported and illustrated by the final ‘Withdrawn’ fold of my art practice, which functions as the foundation or nucleus of my thinking and research. Through studio practice, walking and painting ideas not readily accessed with language unfold to reveal aspects of their character and withdraw again to retain their heterogeneity and complexity. The ‘Withdrawn Fold', is included as an appendix and is called upon throughout the thesis to illustrate ideas, which have evolved during the research. Thus, the thesis is structured to perform its content in that it is constructed from several core ideas or objects, organised into folds and they are held together as a system. Thus, although the practice sits in an appendix it can be understood as an integral component of a distributed ecosystem. Two further appendices are also included on Systems Art and Information Categories, which support the arguments made in the thesis.

Fold 1

Chapter 1

The origins of my systems approach

Chapter 1

The origins of my systems approach

I originally worked in the area of environmental science with a focus on designing and building Geographic Information Systems, (GIS) to organize and present ecological information about specific ecosystems. Central to this work was the concept of the system, and this was used to describe the subject, the ecosystem itself, and the information system designed to describe ecosystems. GIS is a way of dealing with complex information, and like Systems Art has its roots in cybernetics and systems thinking.

The aim was to model, predict, manage and visualise change within a given ecosystem. This would mean modelling how the ecosystem functioned concerning the flow of nutrients and energy through biotic, (living), and abiotic, (non-living) components of the community. To do this, a model or ‘simulation' of the system was built through the integration of environmental data, collected by specialists such as botanists, soil scientists and hydrologists. Many of these ecosystem projects were in remote areas, such as the Andean foothills, and so these incomplete datasets needed to be expanded or interpolated to describe a greater area. This was achieved by calibrating the datasets with satellite images.

The satellite images were used to scan and photograph the surface of the earth to map phenomena at a consistent scale over vast regions. The satellite images were constructed from thousands of pixels of colour, and each colour value was derived from reflected light. Through a mix of rule-based transformations and aesthetic judgement, these pixels values could be manipulated, and emergent patterns could be revealed across the image. Thus, one could distinguish between rock, water, wetland, and forest, based on the colour signals extracted from the data. The result is that the image becomes an index, with each colour, or clustered colour ranges equating to something that may be present on the ground. These were though abstractions of reality generated through a mix of rules and intuition. Thus, there were methodological and conceptual ambiguities at the heart of this work, as it required the employment of rigorous systems to both produce the new material and describe the overarching ecosystems and information systems. Whilst at the same time it drew from other forms of knowledge, experience and information, such as the aesthetic or subjective intuition to work with the satellite images.

There was something uncanny and disquieting about the excavation of these complex images of the earth; as the experience of seeing the complex interrelationship between things, but on such a massive and abstract level was disorienting. As the philosopher and ecological thinker Timothy Morton suggests, 'environmental awareness might have something intrinsically uncanny about it, as if we were seeing something we shouldn't be seeing, as if we realized we were caught in something' (Morton, 2012, pp. 57-8). There was a feeling that the mountains of data gave an accidental glimpse behind the curtain to the unknowably complex ecological systems in operation. Morton, in discussing the process of mapping and modelling global warming captures the psychic costs of such glimpsed revelation.

> Learning about global warming serves to make us feel something much worse than an existential threat to our lifeworld. It forces us to realize that there never was a lifeworld in the first place, that in a sense "lifeworld" was an optical illusion that depended on our not seeing the extra dimension that NASA, Google Earth, and global warming mapping open up. The more information we acquire in the greedy pursuit of seeing everything, the more our sense of a deep, rich, coherent world will appear unavailable: it will seem to have faded into the past (nostalgia) or to belong only to others (primitivism). Some of us will eventually think that we once inhabited this deep, rich, lost world. Others will realize that even this sense of loss is an illusion created by our current modes of seeing. (2012, pp. 55–56)

Thus, there was an uncanny sense that if there are underlying systems in operation and these can be simulated then reality is dislodged or even lost. This feeling alludes to Nick Bostrom's seminal paper, *Are You Living in a Computer Simulation?* (2003), in which he calculated the likelihood that we are living in a simulation, and our reality is a computational construction. He suggested that if we are living in such a simulation, then we could look out for anomalies, or 'glitches' that disrupt the system. This underlying unease with systems and simulations as a way of engaging with 'reality' encouraged a more critical enquiry of systems through art.

One particular systems-based model, which underpinned this early work and has remained central to my art practice, is the concept of the 'ecosystem'. The ecosystem is a flexible conceptual tool as it can accommodate both accurate morphological information for a specific time and place, and broader descriptions, which operate on massive spatial and temporal scales. For example, an ecosystem model can, on the morphological level, describe the specific flow of materials through a river for a given time and location; whilst it can concurrently describe the

overarching processes of erosion, which shaped the river over many thousands of years.

Further, an ecosystem model can be shared between many different academic and professional fields, creating a shared language that transcends the particularities of discipline and method. There will, however, be a level of discrepancy and incompatibility between the different fields, and this emerges in the way that data is collected, interpreted and presented. Therefore, the collected data in such work cannot be considered as 'value-free' as the spatial researcher Laura Kurgen notes,

> 'There is no such thing as raw data. Data are always translated such that they might be presented. The image, lists, graphs, and maps that represent those data are all interpretations. And there is no such thing as neutral data.' (2013, p. 44)

Thus, the collected information may contain empirical, moral, social and political bias and when synthesised with the information from other disciplines the emergent 'new' information has a complex and ambiguous provenance. This also alludes to the idea that the information system, although designed as a simulation of the ecosystem, emerges as a complex system in its own right. Thus, the 'new' information is a product of the GIS and not directly derived from the original subject, the 'out there' ecosystem. This means that the new emergent information and patterns cannot necessarily be directly mapped back to the reality on the ground. Alan Garfinkel makes this point,

> 'complex patterns of interaction, the behaviour of a system cannot be explained solely concerning its atomistic components, despite the fact that the system does not consist of anything else but the basic components and their interconnections. Complex characteristics 'emerge' through the process of interaction within the system'. (Cited in Cilliers, 1998, p. 106)

This leads to the question of what is being represented by these new maps and images. Bruno Latour described this as the 'crisis of representation,' (2005). He described a crisis in confidence concerning the representation of information, and that the terms in which information are received should be recalibrated. He suggests,

> 'We are asking from representation something it cannot possibly give, namely representation without any re-presentation, without any provisional

> assertions, without any imperfect proof, without any opaque layers of translations, transmissions, betrayals, without any complicated machinery of assembly, delegation, proof, argumentation, negotiation and conclusion' (Latour & Weibel, 2005, p. 26)

The issue could then be re-framed, not as a 'crisis of representation', but as a 'crisis of reception'. Thus, such complex systems, and I will argue this includes complex art systems, shift our perception from the production of new information and knowledge to the production of new space in which new ideas and messages emerge. The openness and flexibility of these systems is potentially problematic within the sciences as scientific method is designed to manage our sensuous and critical experience of phenomena, including information, by fixing things reductively, whereas art inverts this relationship. As the philosopher of science Thomas Kuhn notes, ''normal science', overlooks the anomalous quality of human experience'. Polkinghorne, 1983, p. 9). Thus, the work or utility of such systems takes place at the point of reception of the system 'outputs' when the viewer experiences them. And it can be stated that the role of the systems designer as tool-builder and tool-user is to create a simulation of the ecosystem, so these new outputs can emerge (Polkinghorne, 1983, p. 9). The goal of these systems is not then the comprehensive description of the complex 'out there' ecosystem, as this is perceptually out of reach, but to create an informationally productive environment in which the audience can freely navigate.

Thus, these systems, such as a GIS system, can be understood as a simulation of the ecosystems constructed from datasets that model and map the relations between things in the observed world. The relational and networked design underlying these systems can be traced back to pre-computing archival methods, but also to the concept of 'Hypertext'. The information science pioneer Ted Nelson developed this concept in the 1960s, and it referred to a hypothetical model of computer publishing that allowed for branching and relational text. While, from a literary theory perspective the same idea can be traced back to Roland Barthes, whose conception of hypertext pre-dates its practical deployment in computer science. In *S/Z*, (1970), Barthes described how an 'unfinished textuality' composed of words and images could be networked in multiple ways.

> ‘the networks [réseaux] are many and interact, without any one of them being able to surpass the rest; this text is a galaxy of signifiers, not a structure of signifieds; it has no beginning; it is reversible; we gain access to it by several entrances, none of which can be authoritatively declared to be the main one; the codes it mobilizes extend as far as the eye can reach, they are indeterminable . . . ; the systems of meaning can take over this absolutely plural text, but their number is never closed, based as it is on the infinity of language’ (1991, pp. 5–6)

Barthes proposal meant that the reader could have a similar relationship to the text as the author and would be free to navigate and elicit their own meanings from the work. Hypertext and other relational non-linear methods of reception are in effect an implementation of Barthes ideas, as described in *The Death of the Author*, (1967). In this essay, he argued against conflation of the author’s biography with the text, arguing for an independent text that is experienced at the point of reception. As he states,

> ‘the modern scriptor is born simultaneously with the text, is in no way equipped with a being preceding or exceeding the writing, is not the subject with the book as predicate; there is no other time than that of the enunciation and every text is eternally written *here and now*.’ (1987, p. 145)

Two important points, derived from Barthes observation of the author and text, can be applied to systems. Firstly, the system is like a text, and the maps, images and data from the system should be read independently of the biographical roots of the system. This is particularly the case with information systems due to the complex genealogy of the source material, and the hybridity of the methods employed in the collection of materials. Secondly, the materials created within the systems, (such as the maps and images), are emergent properties of the system, and must, therefore, be experienced at the point of reception. This means that such systems are not designed for a single or unicursal reading, but are designed for an open navigation by the end user. The argument will be developed through this thesis that complex contemporary artworks operate in a similar way to such systems, and meanings are generated at the point of reception. Thus, the concepts of the ecosystem and in particular how materials or information flows through them are invoked to describe the increasingly complex role of the artwork.

The Systems Artwork

The complexity of the contemporary artwork can be traced back to the 1960s in which three fundamental changes directly affected the conception of artwork. Firstly, art expanded beyond the singular art object and was freed to operate in more complex ways within society. Secondly, this period saw the development of environmental awareness, and this has permeated our understanding of both the world, our place within it, and the potential role of the artwork. Finally, there was an increase in the use and understanding of systems and information and this has both increased our understanding of the world, whilst distancing us from it.

These changes, the expanded artwork, ecological awareness and system thinking all had a profound effect on shifting our attention from the material object to relationships. Together they can be understood as the first of three system folds that can be observed within culture as it becomes increasingly enfolded within the operation of systems. The three folds can be understood as follows.

First fold: 'Primary Systems,' (1960-1980)

Second fold: 'Open Systems,' (1981-2001)

Third fold: 'Post-system,' (2002-present)

The premise of the thesis is that an artwork can sit across a range of objects, processes and relations and still be understood as a coherent singular artwork in much the same way that an ecosystem can describe the complex ecology of an island or an information system can describe the complex relations of data. From an art historical perspective, the expansion of the art object took place in the first system fold, the 'Primary Systems' fold, with several related movements that expanded the conception of the artwork in a number of significant ways. Firstly, there was the concept of the *Expanded Cinema*, proposed by Gene Youngblood, (1970), in which the relationship between film and audience became an active transaction. Secondly, there was the work of Rosalind Krauss, and her seminal text *Sculpture in the Expanded Field*, (1979), in which the notion of sculpture was

expanded to incorporate architecture and landscape. Thirdly, there was the expansion of Conceptual Art, and in particular Systems Art, which equipped the artist to analyse and productively exploit the underlying structures within art. Systems Art, in particular, has had a profound impact on my art practice, as it shares the same philosophical and systems foundations as those found in environmental science and information systems, but allows for a critical expansion of territory.

Systemic thinking was already well established across many disciplines including the sciences and military planning by the mid 1960s. As the art historian Pamela Lee noted, 'psychology and modern religion; anthropology and urban planning; business management, cognitive science and the ecological movement: all find their place under the Systems umbrella' (Lee, 2006, p. 65). Thus, an increased use of the concept within art in the 1960s was to some degree an extension of this broader 'Systems Turn', but it also fundamentally coincided with the shift away from the art object to the ideas and processes that generated art and were transmitted within the work. The artist and writer Jack Burnham, for example, anticipated the changing status of the art object. In *Beyond Modern Sculpture* he observed,

> 'it is a refocusing of aesthetic awareness – based on future scientific-technological evolution – on matter-energy information exchanges and away from the invention of solid artefacts. These new systems prompt us not to look at the skin of objects but at those meaningful relations within and between their visible boundaries.' (1982, pp. 369-370)

As well as his important writing Burnham organised one of the seminal exhibitions that dealt with cybernetics and systems, *Software* in 1971. In the catalogue, Burnham defined the aim of the exhibition was, 'to focus our sensibilities on the fastest growing area in this culture: information processing systems and their devices' (Burnham, 1970, p.10). Burnham observed that in,

> 'the past few years, the movement away from art objects has been precipitated by concerns with natural and man-made systems, processes, ecological relationships, and the philosophical-linguistic involvement of Conceptual Art. All of these interests deal with art which is transactional; they deal with the underlying structures of communications or energy exchanges instead of abstract appearances'. (1970, p.10)

Much writing on Systems Art has traditionally focused on the cybernetic and conceptual roots, and while these can be seen as the foundations of this work others influences should also be noted. Firstly, there was the aesthetic formalist approach that ran from Malevich, Suprematism and Constructivism, and right through to

Abstract Expressionism. Arne Glimcher the influential gallerist and founder of Pace Gallery, New York, cited artists working in the 1950s, such as Ad Reinhardt, Josef Albers and Alfred Jensen, as systemic as they used colour systems to paint (Glimcher, 2005). There was also the nascent ecological movement that drew on systems thinking that had foundations in both ecology and non-western holistic thinking. There were also developments in social, political and economic analysis, combined with the systemic approach of Fluxus and Neo-Concretism that informed the social engagement aspects of Systems Art. The emergence of Conceptual Art, which generated work through the application of conceptual rules, should also be considered in relation to systems. Appendix 1 explores the roots of Systems Art in greater detail.

Systems Art, during the first fold, can be seen in essentially two forms, and these systemic forms can also be observed within the ecological context. Firstly, there was the application of systems as a tool of production and investigation, and these are described here as 'Rule-based Systems'. Secondly, systems descriptions were employed to give a holistic and critical description of the subject, and these can be named holistic systems or 'Ecosystems'. This distinction between the two employments of the concept of system was understood within Systems Art, with the artist Alejandro Puente describing them in 1968 as 'generating systems' and 'systems as totality', respectively (Behar, 2016).

An example of a rule-based system, (or generating system) is the instruction-based paintings of Sol LeWitt. Like much painting, which employed production systems, the work retained many of the formal concerns of modernism, as the rules were engaged to investigate composition and colour. Whilst art which could be categorised as holistic systems often employed the language, methods and aesthetics of systems to describe or critique the systems operating within art and society. An example of this would be the politically engaged 'Currency' and 'Map' projects of Cildo Meireles, which mapped the systems of power during the Brazilian dictatorship of the 1970s (Shtromberg, 2016).

As noted I originally worked in the area of environmental science and my primary interest was the comprehension of the world in relational terms through the application of systems thinking. Inspired and disoriented by these experiences I

turned to an art practice in order to understand my complex relationship with systems that both encourages and inhibits my investigation, whilst simultaneously describing the underlying dynamics at play in my work, and the ultimate unknowability of complex systems. My practice as an artist is then both systems-based and systems-sceptical and I draw from the history of Systems Art to both ground and reflect upon my practice. As noted Systems Art developed within the first fold, and helped facilitate an expanded conception of the artwork to include new materials and processes. In the following chapters, the concept of Systems Art will be reinvigorated as we encounter the complexity of systems within the vast expanses of information made possible by environmental science, and the flexibility of the systemic concepts offered by 'Actor-Network Theory', and 'Assemblage Theory' and the challenge such relational thinking faces from Speculative Realism.

Chapter 2

The Ecosystem

Chapter 2: The Ecosystem

Overview

As discussed in chapter 1, before developing my practice as an artist I worked within the area of environmental science and mapping, and I am applying the systemic and informational knowledge I developed through this work to my understanding of the art object. This chapter begins with a review of my introduction to the ecosystem concept, and how this idea is bound within a wider holistic outlook, which emerged in the 1960s, but is now returning in a darker implacable form.

An understanding of ecosystems requires a holistic or transdisciplinary approach, as there are many competing interests and ideas at play within such complex systems. The foundations for my holistic thinking about ecosystems began in the School of International Development at the University of East Anglia, a radically interdisciplinary department that considered the interrelationship of things concerning social systems and physical systems. The School offered two interrelated approaches to considering the world, the ecological and the social, with a view to demonstrating the complex dialectical relationship between the material and the social. These two interdependent ways of seeing the world are represented in figure 2.1, which is adapted from Rambo & Sajise, (1984). In the left sphere, the social system contains disciplines that require a holistic engagement with the social systems, such as economics, politics, sociology and anthropology. Whilst in the right sphere the ecosystem contains areas that require a holistic engagement with the physical world through disciplines such as climate, hydrology, and ecology.

This conceptually useful, but ultimately false dichotomy between the material and the social is reminiscent of the 'Great Divide', as described in Bruno Latour's *We have never been Modern*, (1993), between nature and society. In this he describes how the distinction between nature and society is a recent western concept, which has been put forward in part, to allow science and imperialism to function without cognitive dissonance. As he notes,

> 'So the Internal Great Divide accounts for the External Great Divide: we are the only ones who differentiate absolutely between Nature and Culture, between Science and Society, whereas in our eyes all the others - cannot really separate what is knowledge from what is Society, what is sign from what is thing, what comes from Nature as it is from what their cultures require.' (1993, p. 99)

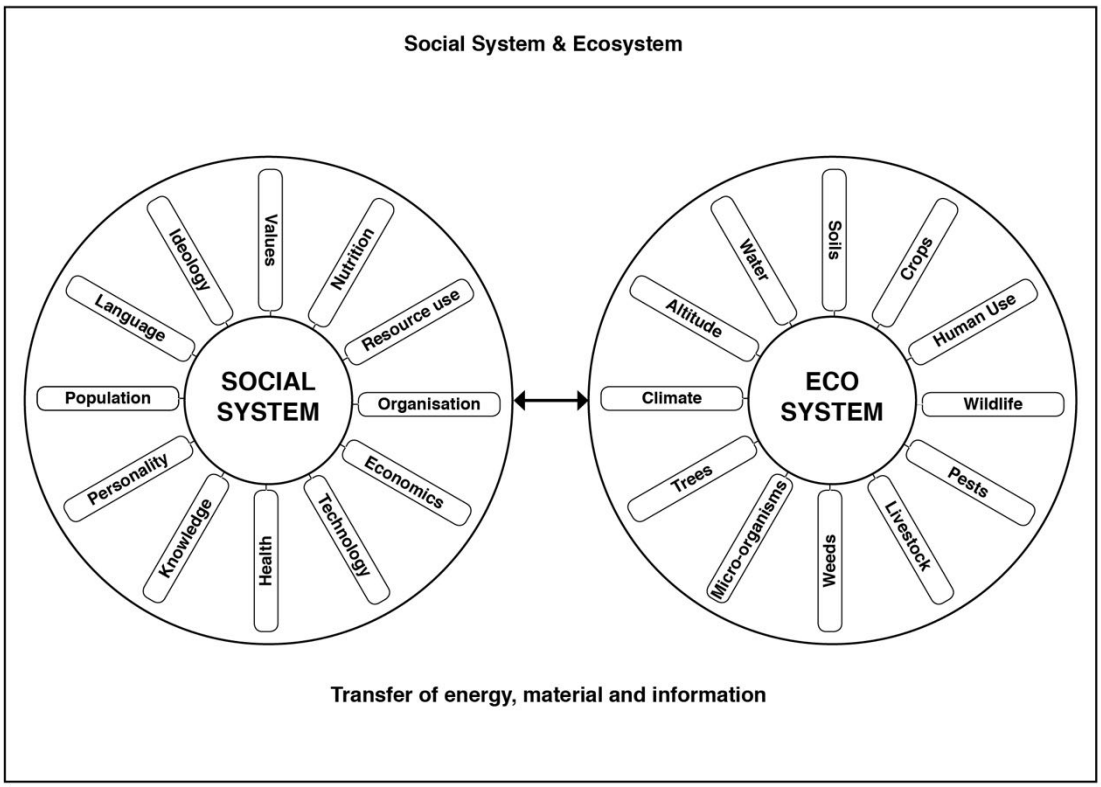


Figure 2.1

Social Systems and Ecosystems
Adapted from Rambo & Sajise, (1984)

In the quote above Latour captures, both the flaws in disciplinary distinction and the skewed thinking required to disaggregate the social from the ecological. This is a false dichotomy that was tackled in the 1960s through the early environmental movement and the integrative thinking of, amongst others, Arne Naess and his concept of 'deep ecology'. This concept can be seen as radical as it shifts ecological or environmental thinking from a rational scientific base to the psyche, and an expanded sense of self to include nature. As Naess states,

> 'Care flows naturally if the 'self' is widened and deepened so that protection of free Nature is felt and conceived as protection of ourselves ... Just as we need no morals to make us breathe ... if your 'self' in the wide sense embraces another being, you need no moral exhortation to show care ... You care for yourself without feeling any moral pressure to do it.'(Cited in Fox, 1990, p.147)

Naess, in his deep ecology, made two distinctions, which are useful when thinking about systems. Firstly, he made a distinction between the concepts of 'holistic' and 'ecological', which Fritjof Capra summarised as follows,

> ‘A holistic view of, say, a bicycle, means to see the bicycle as a functional whole and to understand the interdependence of its parts accordingly. An ecological view of the bicycle includes that, but it adds to it the perception of how the bicycle is embedded in its natural and social environment - where the raw materials that went into it came from, how it was manufactured, how its use affects the natural environment and the community by which it is used, etc.’ (1997, pp. 6–7)

The second useful distinction he made was between ‘shallow' and ‘deep' ecology, which are now widely applied terms in environmental thinking. Capra summarised them as follows,

> ‘Shallow ecology being anthropocentric, and human-centred’, whilst ‘Deep ecology does not separate humans - or anything else - from the natural environment. It does see the world not as a collection of isolated objects but as a network of phenomena that are fundamentally interconnected and interdependent’. (1997, p. 7)

This holistic perspective is currently being reimagined, reframed and clothed in the appropriate language for the new millennium through the ‘dark ecology' of Timothy Morten, (Morton, 2013, 2016) and the ‘non-human turn', of Jane Bennet’s *Vibrant Matter*, (2009), and the *Alien Phenomenology* of Ian Bogost, (2012). It could also be argued that the current dark ecological, non-human turn is in part, a response to the failure of the anthropomorphic environmentalism of the past thirty years. A clear exception to this atmosphere of resignation found within these contemporary texts is the ecological systems thinking of Fritjof Capra and Pier Luigi Luisi, (1996, 2002, 2014), and Stephen Harding’s *Animate Earth*, (2006), which offers a positive re-examination of the animism developed in James Lovelocks’ seminal text ‘Gaia’ (1970).

Harding’s *Animate Earth* motivated me to return to the concept of ‘Gaia’ as a sentient ecosystem, and I re-read several historically significant ecological texts from this first fold. The language used in these texts and the pictures they drew of the world as an integrated ecosystem gave me a very particular sense of comfort, melancholy and loss. There is a word in Portuguese, ‘saudade’, which describes a deep nostalgia or melancholic longing for a something absent that one loves, and I felt saudade in reading these texts. I felt saudade for the lost positivity of the 1960s, although I never directly experienced it first-hand. I also felt saudade for the lost innocence of language, reading its direct employment to communicate ideas; but

most of all I felt saudade for the world these writers described and wished to save, as it already feels lost.

Thus, I returned to several texts of the first fold of holistic and systemic environmental awakening. Rachel Carlson's *Silent Spring*, (1962), which articulated the role of agriculture in poisoning the earth, and Buckminster Fuller's *Operating Manual for Spaceship Earth*, (1969), which conceptualised the planet as a spaceship that needed maintaining. Whilst on a practical level I read Chorley and Kennedy's *Physical Geography*, (1971), and Eugene Odum's *Fundamentals of Ecology*. I have drawn from Physical Geography, as it describes the processes of the ecosystem in very clear terms, and these are re-employed here to describe the artwork. Whilst Odum's text is recalled as a marker for a more cooperative perspective that ran through environmental thinking, and although published in 1953 and came to prominence in the 1960s is still published today.

The concepts of 'Gaia', 'Spaceship Earth' and the 'Ecosystem' all came to prominence during the dawning of environmental awareness within the first fold, and this awareness manifested itself in developments in both science and culture. Thus, whilst there were developments in science towards a more integrated view of nature the same underlying forces were affecting change in art and popular culture. From an art perspective, artists were reconsidering their engagement with the land on both a sculptural and personal bodily level. The large-scale Land Art of this period was more accurately environmental than ecological in nature, as it foregrounded the material earth over the underlying biological systems. This understanding of 'environment' can be traced to Allan Kaprow's environmental installations, and these led to the earth moving works of Walter de Maria, Jan Dibbets, and Nancy Holt. Whereas the early Systems Art of Hans Haacke and the personal and biological Systems Art of Agnes Denes, such as *Rice/Tree/Burial* project, (1968) and Mary Kelly's *Post partum document* (1975) would be more accurately described as ecological and biological in outlook. Whilst the work of Robert Smithson traversed the divide between the environmental Land Art, and ecological systems art with works such as, *Spiral Jetty*, (1970), which operated both as sculpture and complex or 'distributed' System, (Halsall, 2008, pp. 146–151).

As noted the same cultural factors were influencing both art and science during this period that shifted thinking towards a more ecological and systemic way of seeing the world. This holistic shift was particularly apparent in environmental science and the privileging of the ecosystem concept. The key driver for this was Odum's holistic thinking captured in the *Fundamentals of Ecology*, as it foregrounded the responsibility of humans within the ecosystem. This was the first major text which according to Hagen,

> 'Unified plant and animal ecologies, which previously had been quite separate specialties. It also directed attention to the importance of bacteria, fungi, and other organisms that often had been ignored by earlier ecologists. By joining the living community and the non living environment as a single, interacting entity, the ecosystem concept provided a focus for studying pollution, habitat destruction, overpopulation, and other pressing environmental problems. Using the conceptual framework of energy flow and nutrient cycling, the idea of an ecosystem was sufficiently abstract and flexible to explain the operation of something as small as a spacecraft or as large as the entire biosphere'. (2008, p. 705)

Odum's cooperative perspective of the ecosystem traversed the 'great divide' observed by Latour, as his view of the ecosystem, was one of a social-ecological dialectic. Arguing that both the ecological world and social worlds co-evolved 'toward greater complexity, interdependence, and self-regulation' (Hagen, 2008, p. 708). This positively inflected view of the cooperative 'spaceship earth' and its in habitants, started to shift at the start of the 1970's, when the Darwinian ideas of self-interest started to re-emerge within ecology. Garrett Hardin's *The Tragedy of the Commons*, (1968), for example, stressed that populations could not be understood in terms of cooperation, but through individual self-interest. This was underpinned by a general move within ecology and biology to think in evolutionary and competitive terms, exemplified by Richard Dawkins and the *Selfish Gene*, (1976). Dawkins was aware of the wider implications of this perspective and suggested that

> 'if you wish, as I do, to build a society in which individuals cooperate generously and unselfishly towards a common good, you can expect little help from biological nature. Let us try to teach generosity and altruism, because we are born selfish'. (2016, p.3)

The shift in tone from Odum's cooperative ecology to the 'realist' ecology was seen in the shift in emphasis within ecological education also with the wide uptake of Pianka's *Evolutionary Ecology*, (1982) which emphasised competition. With its emphasis on competition this text could be read as an early form of post-humanism,

as Pianka speculated that humans would inevitably become extinct. However, he suggested that, ‘this was not a cause for pessimism because after humans were gone natural selection would continue to produce new species’ (Hagen, 2008, p. 707). It also marked the decline in the optimism of the 1960s and the shift toward individualism, which would reach its zenith in the late 1980s culture of self.

This was the period I began my undergraduate education studying the environment and development, and I had the privilege of being educated in a department, which remained resolutely integrated, systemic and cooperative in its outlook. Thus, Odum's practical model of the ecosystem and the spiritually deeper deep ecology of Naess prevailed in shaping my early understanding of the ecosystem. This model of the ecosystem, which describes the world of things and their interactions, helped shape my engagement with the world, and it is something I have returned to in order to describe the artwork and its operation.

Ecosystems

The model of the ecosystem to some degree predates Odum's description, as it is the product of a long history of systemic or holistic thinking. Within science, there has been an oscillation between integrative descriptions, such as the ecosystem and mechanistic systems that focus on the distinct parts of the experienced world. Before the development of 'western science' more integrative and holistic pictures of the world held sway, such as various forms of animism, the concept of Gaia, and Buddhism. Animism sees the world as constructed from people, animals, plants, and through to trees, rocks, and rivers, and they all possess a living spirit. Thus, from an animistic perspective, the world is not split between subject and object, but is a complex set of relations, without a clear hierarchy. Aspects of animism can be seen in the Shintoism, Hinduism and Buddhism, as well as many pagan belief systems. Such beliefs cannot necessarily be reduced to the idea that all things are equally alive, but rather may be a way of describing a relational understanding of the world. Thus, Animism is a way of visualising one's relationship with trees, a river or the seasons (Harvey, 2015, p. 4).

The idea of the ecosystem grew from the increasingly holistic ideas that developed in biology. Before this Descartes' mechanistic description of the world explained observed phenomena in terms of the machine which could not account for the emergent property of life. A further and arguably more fundamental paradigm shift away from the Cartesian-Newtonian worldview came with Charles theory of evolution in *Origin of Species* (1859). Darwin proposed the radical idea that all life had a common ancestry and through a process of natural selection over billions of years different species had adapted or evolved to flourish in particular environmental conditions. As Capra notes these ideas caused a shift in biology from,

> 'perspective from being to becoming. Moreover, by realising that all living organisms are related by common ancestry, the Darwinian conception of life was utterly holistic and systemic: a vast planetary network of living beings interlinked in space and time'. (Capra & Luisi, 2014, p. 36)

The concept of ecosystem is employed here as a way of understanding the artwork in systemic terms. Several aspects of the ecosystem are highlighted that are useful in this discussion. Firstly, the way that an ecosystem is made up of different parts and this can remain in balance through the constant exchange of energy and

information through feedback processes. Secondly, the influence of entropy, and chaos within systems, and how these contribute to the unknowable nature of systems. In addition to these ideas, the ecosystem contains concepts and classification tools that are useful in thinking through my practice in practical systems terms. This chapter discusses these tools, and they can be summarised as follows. The first useful concept is how systems are defined in terms of their boundaries. Secondly, the way systems can be classified as 'Isolated', 'Closed', or 'Open' systems. Thirdly, the classification of ecosystems in terms, of scale, processes and parts is introduced, and these are applied to artworks contained in appendix 3. Finally, the shift in perspective, originally observed in biology, from 'being' to 'becoming', is fundamental in understanding the contemporary role of the artwork. As the work is alive, relational, and meaning emerges at the point of reception.

These concepts are employed analogically to the production of the artwork from the perspective of the artist. It is recognised that concepts such as 'hierarchy', for example, which can be seen operating at the production stage of a work, are insufficient concepts to describe the work at the point of reception. As when the artwork enters the wider circulation of things hierarchies to some degree disappear, as the object or system becomes one-amongst-many things, and other systemic tools are required to describe them within the world. These tools are introduced in chapter 5.

Pullin defined the ecosystem as a 'community of living organisms together with the physical processes that occur within an environment' (Pullin, cited in Dickinson, 2006, p. 1). Whilst Capra defines an ecosystem as an abstracted description of the interactions of life forms and their environment observed on earth. He defined them as, 'a community of different species in a particular area, interacting with its nonliving, or abiotic, environment (air, minerals, water, sunlight, etc.) and with its living, or biotic, environment (i.e., with other members of the community)'(Capra & Luisi, 2014, p. 342).

Core to the concept of the ecosystem is that the planet is a ‘top-down' system supporting the individual, as opposed to a group of individuals building a ‘bottom-up' system. As the biologist, Harold Morowitz states, ‘life is a property of planets rather than of individual organisms' (Morowitz, 2009. p.6). Later in the text, which is focused on the cellular life, he states, ‘sustained life is a property of an ecological system rather than a single organism or species’ (2009. p.54). Whilst, in the more expansive text, ‘*The Emergence of Everything*, (2004) Morowitz expands this idea to its logical inauguration with the ‘big bang', as the start of life. These concepts of ‘top-down', or downward causality and ‘bottom-up', or upward causality, are key to understanding the two essential forms of systems in relation to the artwork. Thus, these concepts are returned to throughout the text, as we encounter them, in different guises, within ecological, social and philosophical contexts. It should be noted, however, that in both the physical and social contexts nothing is ever solely upwardly or downwardly causal, as there is dialectical relationship between these forces, as dynamic systems are balanced.

There is then a difference between the biological and ecological perspectives. Biology has traditionally focused attention on individual organisms rather than on the wider systems in operation. Whereas the ecological perspective examines, ‘the proto-ecological cycles and subsequent chemical systems that must have developed and flourished while objects resembling organisms appeared' (Capra & Luisi, 2014, p. 341). Thus, ecological systems perspective concerns itself with the ecosystem, (as the underlying structure of the narrative), and describes the world in terms of the flow of interactions between all living and non-living phenomena.

Ecosystems are then a form of descriptive system, and consequently, system theory is employed to describe and predict the mechanisms operating within these complex structures. A systems approach to understanding ecosystems and social ecosystems deconstruct the physical and social interactions taking place into objects, forces and relations. Rain, for example, can be seen as a thing or even an object, but its boundaries as an ambiguous object are ever changing due to the forces and relations acting upon it.

To categorise something observed as an ecosystem, from an environmental science, ecology or physical geography perspective the following characteristics

need to be observed. Firstly there is a consistency of function concerning the input and output of material. In physical systems material equates to energy and matter while in social and art systems information and affect, (which is a form of information), can also be considered material. Secondly, objects or actors within the system have both functional and structural relationships between each other to allow the flow and transfer of material. Thirdly systems have definable borders with the outside environment and other systems, and they can exchange material with them through input and output processes. Finally, the systems function the way they do due to the presence of the morphological driving forces, such as gravity and heat; and the impact of these forces are observable.

In ecological terms, the boundary of the system defines what is inside the ecosystem and consequently a property of the system or something outside the system. Something external to the ecosystem can then either be ignored in systems terms, having no consequence for the system, or it can be framed as an external force or input to the system. The problem, however, is the boundaries of ecosystems are mental constructs. Even with a 'singular' living thing, its' boundaries are porous and ill defined. As Morton notes,

> 'Boundaries are not perfectly defined. An oyster makes a pearl by secreting fluids around a piece of grit it has accidentally absorbed. Surgeons can transplant organs. The same thing occurs at larger scales. You only have to think of a coral reef to realize how life has influenced Earth.' (2012, p. 39)

This ambiguity of the boundary of the system can be illustrated with a tree, which is a complex ecological system that extends beyond the woody material and encompasses the ecosystems of the branches and root systems and into the wider forest. This understanding is currently undergoing a paradigmatic shift through the work of Wohlleben, (2016) who demonstrated that trees not only have a symbiotic relationship with lichen, but operate together as a complex system, and communicate stresses through a forest via mycorrhizal, (fungi) networks.

There are essentially three properties found within the boundary of the system. Firstly there are the elements such as raindrops, plants and animals. For consistency across the discussion, we will call the elements objects (and later actors), as these are the discrete units of study. Secondly, each object has measurable attributes, such as size, colour, volume, and mass. Thirdly there are

relationships between both the objects and their attributes, and amongst objects. Although these categories are specific to the description of systems, they align with the universal metaphysical qualities. For example, the quality of ‘type' or ‘kind' equates to the object, as all three can describe both the category of 'tree' and a specific tree. While the metaphysical ‘properties' is equivalent to the attributes of trees or a specific tree, and the metaphysical concept of relations describes the relationship between trees in the same way that a system description would describe relations. (Bigaj, 2012, p. 16)

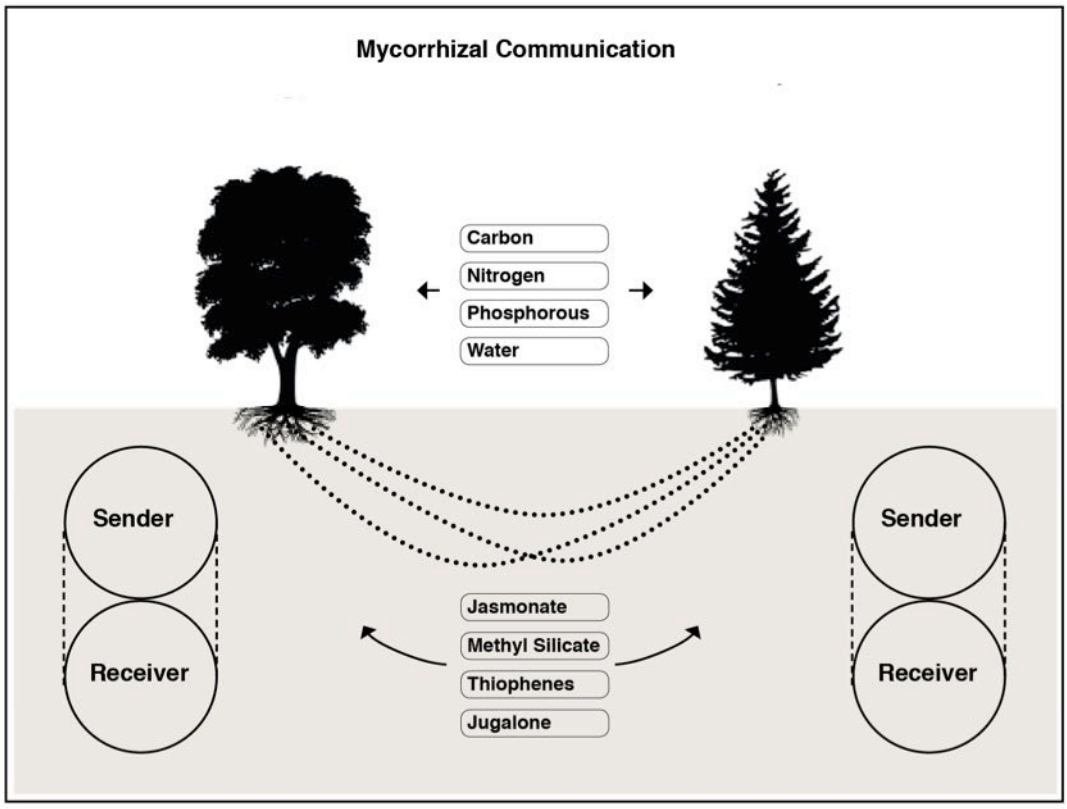


Figure 2.2

Mycorrhizal Communication

The power of the ecosystem as a concept is that it operates at the crossroads between observed objects and observed forces emanating from and acting upon the objects. That is, the ecosystem facilitates a description of the world, (or an artwork), which balances the experienced object with its impact on the world. On a practical level for the ecologist or geographer the study of the world, made up of complex objects and complex physical and social interactions, is always to some degree subjective. The scientific approach to studying things is to desegregate them

into isolatable objects, such as sea slugs, rain and mountains, and consider how they operate or interact with other parts or elements in simplified conditions. This is the basis of empirical science, but as already alluded to this process is subjective. As Chorley & Kennedy state,

> 'although intellectually necessary, this decomposition of the real world into simplified structures is an entirely subjective product of the mind of the investigator…Isolated structures are therefore subjective and artificial portions of reality, and the biggest initial problem is the identification and separation of meaningful sections of the real world.' (1971, p. 1)

These objects and the forces that act upon them can be organised in functional and structural terms. An ecosystem, for example, described in functional terms is organised regarding the biotic and abiotic components of a habitat. Biotic components would include microbes, plants, and animals and all inorganic matter and energy can be defined as abiotic components; whereas, a structural description of an ecosystem classifies the biotic and abiotic components concerning their structural complexity and interrelatedness. Moreover, both the functional and structural descriptions of an ecosystem are useful in an art context and will be described here.

Isolated, Closed and Open Systems

Systems, ecosystems and art systems can be classified in terms of their openness to the wider world. That is, the degree to which energy or information can enter or leave the boundaries of the defined system. There are three functional classifications, concerning how the ecosystems interact with the wider world. These are isolated systems, closed systems, and open systems. An isolated system is a system that has no interactions with the outside world and is closed to the import and export of both mass and energy, (Chorley & Kennedy, 1971, p. 2). Laboratory experiments in which all of the variables can be controlled are this type of system, but in reality, most systems outside of these strict laboratory conditions cannot be described as closed.

Whilst an isolated system is more of a theoretical model closed systems are observable in the real world. These systems transfer energy, but not matter, across their boundary to the surrounding environment. The earth and its atmosphere represent a system, which is effectively a closed system, as it exchanges energy with outer space, through the absorption and release of heat. The earth does not though exchange mass with its neighbours and break into parts, which are lost in space. Another simple example of a closed system is a closed terrarium in which plants can grow and can be sustained in the long term in a sealed glass container, with sufficient water and organic matter. The only input into both of these closed systems, the earth and terrarium, is the radiant energy from the sun.

The third classification, open systems, transfers material to the surrounding environment and most ecosystems can be described in these terms. As Chorley & Kennedy state,

> ‘The components of such systems and the interrelationships between them tend to become adjusted so that there is a steady output of mass and energy (or information) which is equal to the input. Such adjustment is termed self-regulation operating to produce a steady state.' (1971, p. 2)

The difference between these systems and the closed terrarium ecosystem is that the open systems can exchange material directly with the broader environment. Thus, it is the equivalent of taking the plant out of the glass terrarium and planting in the wider open environment.

Classification of Systems concerning flow

Thus, the preceding models of isolated, closed and open systems help describe the degree to which the ecosystem, (or artwork), is separated from the rest of the world. In addition to this ecosystems can be classified based on the flow of material and information through the system. In ecology and physical geography there are four useful models that help describe and visualise these flows. These are the Morphological system, Cascading system, Control system and Process-response system, and these are useful analogical tools in further describing the flow of ideas material and information through artwork or system. These will be briefly described and then used to demonstrate the systems concept of feedback in appendix 3.

Morphological systems are attributes or characteristics of a system. That is, 'emergent behaviours' that appear through the interaction of things. In ecological terms, morphological systems are clearly definable and observable processes, which are not independent objects in themselves but are processes that can be observed within a wider system. Chorley gives the example of a beach, and its morphological properties will include such attributes, such as, 'beach slope, mean grain size, range of grain sizes, beach firmness' (Chorley & Kennedy, 1971, p. 5). Thus, these are not things in themselves, but parameters that describe a characteristic of a wider system, and it is how these interact that defines the beach. Thus, the particular calligraphic techniques employed by Cy Twombly, for example, could be described as a morphological system, as they are a force that influences the structure of his work, but his work cannot be explained by solely referring to this technique.

Cascading systems can be described as chains of subsystems. Chorley & Kennedy describe these subsystems as 'dynamically linked by a cascade of mass or energy. In this cascade, the mass or energy output from one subsystem becomes the input for the adjacent .. subsystem' (1971, p. 5). A simple example of this is a food chain that leads from algae and photosynthesis and through to whales, as the sunlight powers the production of algae, which in turn is a source of energy for the whales. Thus, the emphasis in such systems is the relationship between the inputs and outputs of the system, and this can help understand the causal relationships in the production of work.

Process-Response systems are essentially the merging of the processes in the morphological and cascading systems, meaning a system with inputs and outputs, which exhibits feedback responses. These systems are thus kept in balance through both the input-output mechanism and the internal feedback mechanisms that can jettison excess material or information. These systems are also analogous to how information flow is modelled, and this will be developed further in chapter 3 on Information Flow.

Finally, Control systems are systems in which intelligence can 'intervene to produce operational changes in the distribution of energy and mass within cascading systems, and consequently to bring about changes in the equilibrium relationships involving the morphological variables linked with them in the process-response systems' (Chorley & Kennedy, 1971, p. 10). That is, where there is activity in the system, to either positively or negatively affect the input, output or feedback operations within an ecosystem at a specific spatial and temporal scale. For example, the management of the forests of Scandinavia is a conscious intervention at a regional scale, but the lack of management of climate change on a global scale potentially undermines the forest management due to the melting permafrost across Scandinavia, Siberia, Alaska and Canada. These models are far more complex than the simple morphological processes as it is attempting to model not just the flow of materials, but the way they are mediated by sentient actors, and thus, the information systems models discussed in the following chapter are more capable of describing systems of this complexity. For example, if we consider the complex artwork 'The Creation Myth', by Jason Rhoades, (1998) the flow of materials and information can be described in morphological terms, but the overall work is mediated by a complex control system in which Rhoades would, (during the original installation of the work), managed the ebb and flow of materials and interactions taking place. Thus, these models are used as analogical tools in the 'Withdrawn Fold', (appendix 3) to imagine the flow of material and information through an artwork.

Feedback, entropy, chaos, and emergence

One of the main features of all systems is feedback, and how the circulation of material at the sub-system level, (cascading systems) affects the functioning of the overall system. The essentially theoretical isolated systems described above, are completely closed and obtain no additional inputs of energy. Thus, the tendency of the energy already present within isolated systems is to be redistributed randomly. This randomness or lack of structure is known as 'entropy', and as noted in Chorley & Kennedy, as the

> 'entropy increases through time, it represents a decrease in the amount of energy available for work, a levelling-down of differences within the system and destruction of its hierarchical organisation. This process continues irreversibly until the isolated system reaches the static equilibrium of an undifferentiated structure, with a uniform distribution of energy and entropy at a maximum'. (1971, p. 13)

It could be argued that this dissipation of structure takes place in an artwork which fails to engage with the wider world, and is therefore not being aesthetically or critically moderated, as part of the wider art system. Robert Smithson understood and channelled many of these systemic ideas through his work including the concept of 'entropy'. In many commentaries, Smithson's entropy has often been incorrectly reduced to an allegorical mediation on decay in nature or industrial breakdown. However, it seems apparent within his writing that his understanding of entropy within systems was somewhat more literal than this, and he was well aware of the dynamics at play in trying to keep a system in balance. The following quote, for example, demonstrates his grasp of the complexities in balancing and sustaining systems.

> 'My thoughts are like an avalanche in the mind, in the sense that they are breaking apart; there's no information that can't be collapsed or broke down, so that it's not a matter of establishing a perfect system. There is no perfection in this situation. There is no perfection in my range, because my thoughts as well as the material that I'm dealing with are always coming loose, breaking apart and bleeding at the edges' (Smithson cited in Osborne, 2013, p. 114)

Whilst 'isolated' systems effectively collapse into disorder 'open' and 'closed' systems are sustained and kept in balance through the transfer of matter and energy, and in the later examples of cybernetic and art systems the transfer of information also. This imported energy keeps the energy levels in balance and is described as 'negative entropy'. Open and closed systems are complex, and they

are composed of sub-systems, which circulate energy internally, through the process of feedback to keep the system in 'homeostatic' balance. Edward Shanken, for example, gives the homeostatic example of the human body's ability to self-regulate and maintain a temperature of 37 degrees Celsius (2015, p. 13). Without this balancing of material within the system the individual organism, complex ecosystem, or art system will become unstable and collapse. Thus, systems transfer material in, around and out again through positive, negative and positive-negative feedback loops.

These patterns of the transfer of material are, though, quite complex to map as they do not operate in simple cause and effect terms. Simple 1-to-1 relationships operate within simple linear systems, but most systems and processes observed in nature are complex or non-linear. A small change in a simple linear system would produce a small change, whereas as a small change in a non-linear system could instigate large unexpected changes within the system. An example of this is the 'butterfly effect', described by the meteorologist Edward Lorenz. This is a model of weather constructed from three nonlinear equations, and it demonstrated that such nonlinear systems were extremely sensitive to even the smallest changes and would generate massively complex behaviour.

Emergence is a key concept in system thinking as the changes within a nonlinear system are unpredictable and can be described as emergent qualities of that system. Emergence is an idea that permeates ecology and ecosystems on many levels, from the complex operations of weather as demonstrated by Lorenz down to the molecular level. Life, for example, can be accurately described as an emergent property of a cell, or at the higher level the organism. These complex systems are exhibiting self-organising qualities, (autopoiesis**),** and this is an emergent property of the system. The life of a tree, for example, cannot be understood by dividing it into the smallest observable parts. (Halsall, 2008, p. 43)

Likewise, an artwork will demonstrate similar system attributes, such as feedback and complexity and its function cannot be understood by describing the constituent parts; as its 'life', or independence as an artwork is an emergent quality. My painting practice is considered in terms of direct, positive, negative and positive-negative feedback loops in the 'Withdrawn Fold', (appendix 3).

Structural classifications of systems

Understanding the world in terms of structure and hierarchy permeates ecological thinking and can be traced back to Darwin's observations of species and family trees. Structural and hierarchical thinking is integral to the idea of the ecosystem and is applied at different spatial and temporal scales to flora and fauna. At the 'Micro' scale an ecosystem can be tiny, sustaining life in a puddle over a short period, for example. Whilst at the medium, or 'Messo' scale an ecosystem could be a forest or lake. While massive ecosystems or set of interconnected ecosystems, such as a vast rain forest, or desert are described as Biomes. These can influence the lower level Messo and Micro Ecosystems, as well as the macro level environmental dynamics of the global, or 'Ecosphere' level. (Dickinson, 2006, p.2)

Part of the power of the ecosystem concept is that it is created in the mind of the observer and it is therefore abstract and flexible. One cannot fix the boundaries or constitution of an ecosystem, (or an artwork), as these are arbitrary, subjective and dynamic. They are though, to some degree, observable systems that are made up of visible objects, even if their constitution is subjective and changes over time. An ecosystem, for example, could be made up of plants, animals and the environment. Whilst drilling deeper the specific plants and animals can also be understood in system terms as 'living structures', which are in turn supported by simple 'Self-maintaining systems', such as cells. Whereas the artwork could be made up of an idea, an experience, paintings, drawings, and a film, and this can still function as a single art system. Whilst expanding the description further the ecosystem can encompass the artist, the audience and space, if the sustainability of the work in systems terms requires their inclusion.

The Resolution of Structures

Thus, one approach to understanding and organising phenomena in the world concerns structural complexity. Some systems are more complex than others, and they can thus, be ordered concerning complexity. The following list, developed from the categories defined in Chorley and Kennedy's *Physical Geography*, (figure 2.3), is interesting, as it organises phenomena regarding structural complexity, but does not differentiate between systems and objects. Instead, it lists all the main categories of physical and cultural systems and orders them in terms of complexity. (Chorley & Kennedy, 1971, pp. 3–4). Thus, at the bottom of the hierarchy are the morphological processes, and cascading systems described earlier, which are not independent objects or systems, but forces that contribute to a definable object or system. Whereas at the top end of the hierarchy is the social-ecosystem, which is a description of the physical ecosystem enmeshed with the social system. In these complex systems, the exchange of material is extended to include information, as well as Matter and energy. (Luhmann, Baecker, & Knodt, 1996)

Increasing complexity ↑	Category	Description
	Human Ecosystems	The interlocking of social systems with ecosystems
	Social Systems	Complex human systems
	Human	Complex living structures with self-awareness
	Ecosystems	Systems made up of plants, animals and environment
	Animals	Complex living structures
	Plants	Living structures
	Self-maintaining systems	Simple living structures cells such as cells
	Control systems	Process-response systems in which the key components are controlled by some intelligence
	Process-responses systems	Linkage of at least one morphological and one cascading system
	Cascading systems	Systems defined by the path followed by throughputs of energy or mass
	Morphological systems	Network of structural relationships between system parts

Figure 2.3

'Hierarchy of Structures'

Developed from Chorley and Kennedy's Hierarchical system (1971)

This list above can be simplified and revised to make explicit the scale of the phenomena operating within systems, whilst avoiding the politically loaded term of hierarchy. Thus, things can be considered in terms of observable resolutions, which shifts the organisation of material onto to a sensual and conceptual basis. Resolution as a mediating term draws directly from working with remotely sensed

data images, as these data were captured at different spatial and temporal resolutions. In this revised model of 'Systems Resolution' phenomena can be categorised as either simple processes, more complex objects, which are a form of system, and through to complex systems. This thinking tool is useful in understanding, both the relative complexity of the observed phenomena and the resolution of observation. Thus, depending on the focus, (resolution), a raindrop, can be seen as a small body of water, part of a rain storm, or part of the hyperobject of global warming.

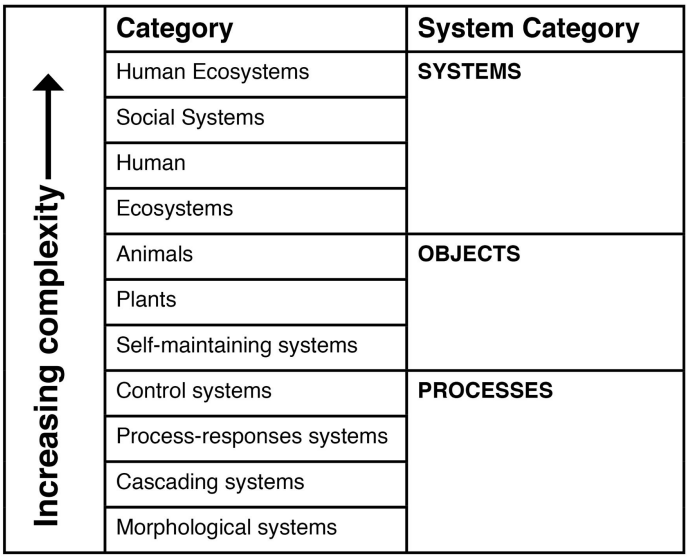


Figure 2.4

Structural Resolution

Likewise, depending on the resolution of observation, a single mark on a canvas can be seen as a mark, part of a painting, or part of the wider distribution of the artist's practice. Thus, seen through the lens of resolution in this way the practice of an artist can be understood in clear systems or even fractal language.

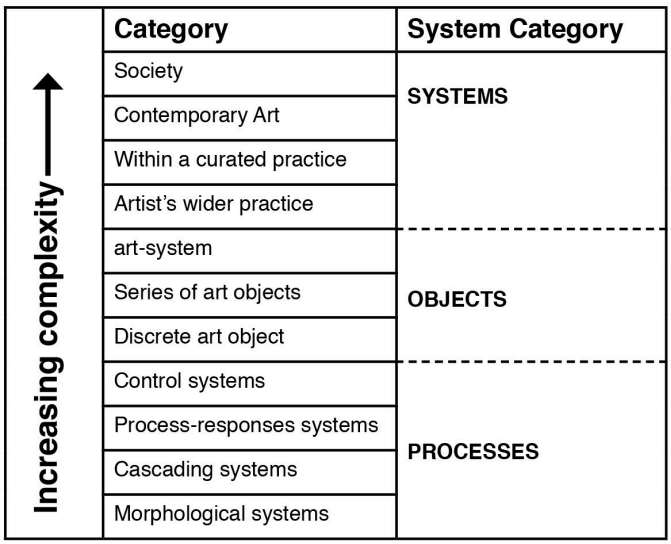


Figure 2.5

Structural Resolution applied to the artwork

Community Scale

Considering nature, the world and art in terms of resolution helps to mentally arrange things in terms of relative complexity, whilst foregrounding the subjective role of observation. It helps distinguish between the objects and systems we are observing and whether something observed is a genuinely emergent phenomenon of a system or a socially constructed description. This distinction can be made clearer through the example of the cell and the ecosystem. As noted, a cell is a living structure, and can be understood as both a semi-independent object in its own right, but can also be understood as a system, and the life of the tree built from these cells can be understood as an emergent property of these cells. Thus, in scale terms, this emergence demonstrates 'upward causality', or appears 'bottom-up', meaning that the system does not need an overarching intelligence to emerge. In contrast, an ecosystem is socially constructed by the observer, and can be described as having downward causation, or is a 'top-down' system. Likewise an art practice is, on a material level, constructed from the work the artist brings into the world. Thus, the artworks and wider practice of the artist can be understood as emergent properties of this work. The descriptions of the artist and their practice are 'a posteriori', and several competing descriptions of their practice could be put forward to explain the artworks. It is at this level between upward and downward causation where ecological, Assemblage and Actor-Network descriptions of systems meet to explain what we experience in slightly different ways.

Top-down systems are more common in socially constructed contexts, such as politics and business, in which the organising principles are disseminated down, and impact lower levels of the structure. Schroder defined downward causation as,

> 'The influence the relatedness of the parts of a system has on the behaviour of the parts ... it is not the influence of a macro-property itself, but of that which gives rise to the macro-property, viz., the new relatedness of the parts.' (Cited in Luisi, 2002, p119).

In a biological context, it is understood that there is a dialectical relationship between emergence and downward causation, in the sense that there is a relationship between the emergence of life from cells, but also the cells and life itself are in turn mediated by the animal. Varela (2017) described the occurrence of emergence, (upward causation) with downward causation as 'cyclic causality' in a biological context.

It is therefore useful to consider how an artwork is developed in terms of both upward and downward causation. That is, an artwork may be created from a set of rules, and this demonstrates upward causation. There will, however, be a point at which the emergent character of the work appears to the artist, and they may intervene in this process; Thus, demonstrating downward causation. It could be argued that such work, that demonstrates this cyclic causality, is more interesting, as it is informationally richer than the purely generative work. As the risk with rule-generated work is the potential exhaustion of meaning, once the underlying system is understood. Whereas an artwork whose underlying rules have been disrupted by the artist is informationally richer, and can consequently accommodate new meaning.

Increasing complexity ↑	Hierarchy	Description of relationships	Decreasing population ↓
	Biosphere	Macro-scale environment	
	Biomes	Meso-scale environment	
	Ecosystems	Defined envelope of environment and biota conditions	
	Functional Groups	Sets of environmental pressures within tolerance range of species-functional group	
	Communities	Sets of environmental pressures within tolerance range of species-community	
	Populations	Other populations and micro-scale environments	
	Organisms	Individual of species	

Figure 2.6

Community Scale

Thus, another useful way of considering the experienced world is in terms of communities of similar things, or ‘Community Scale’. From an ecological perspective the primary community is the individual organism, and the most complex community being the totality of the biosphere. A general observation that can be made is that the ‘givenness' of the object or system decreases as the complexity of the community increases. Likewise the need for descriptive systems increases, as the complexity of the community increases. This can be illustrated below by applying this to humans, (figure 2.7). A single human is simple to comprehend as a community of one. Likewise, a family is relatively easy to fix as a community, based on either biological or social criteria. However, as one moves up the hierarchy the definitions of the communities become harder to fix. This model draws inspiration from the ‘Hierarchy of Life’ model (Dickinson, 2006, p.4)

Increasing complexity ↑	Hierarchy	Description of relationships	Decreasing population ↓
	World/World region	Macro-scale environment	
	Country	Meso-scale environment	
	Region	Defined envelope of environment and biota conditions	
	City	Sets of environmental pressures within tolerance range of species-functional group	
	Local Community	Sets of environmental pressures within tolerance range of species-community	
	Family	Other populations and micro-scale environments	
	Individual	Individual of species	

Figure 2.7

Community Scale, applied to the human family

As can be seen the community of humans can be described in terms of the family, neighbourhood and regions, as this does indeed describe their habitation arrangements. It does not, though, explain their social interactions as these cut across the scales and topology. This is where, from a social interaction perspective, Actor-Network offers a more flexible description, as it allows the individual to operate at the individual, family and even global level within different contexts and this is discussed further in Chapter 5.

The scale of the community is, though, a useful tool from an art production perspective, as it allows the artist to locate the object relative to other objects. Thus, if an artist paints, or collects stones, they will be able to classify objects in terms of 'painting' or 'stone'. This allows them to distinguish between the things they are interested in, the foreground objects, and the background, (everything else). Once things are mentally captured in this way the artist is then empowered to redeploy these things within more complex systems. This ability to disaggregate in this way is important due to the increasingly flat world in which everything, (or its simulation), is equally available. Morton notes the danger of this equal access to everything in the following,

> 'in a situation in which everything is potentially significant, we're lost. It's the same situation the schizophrenic finds herself in. She is unable to distinguish between information (foreground) and noise (background). So she hears voices coming from the radiator, yet hears speech as meaningless burbling. Everything seems threateningly meaningful, but she can't pin down what the meaning is.' (2012, p. 30)

Increasing complexity ↑	Hierarchy	Description of relationships	Decreasing population ↓
	Total Practice	Macro-scale environment	
	Related Ecosystems	Meso-scale environment	
	Ecosystems	Defined envelope of environment and biota conditions	
	Related series of art objects	Sets of environmental pressures within tolerance range of species-community	
	Series of art objects	Other populations and micro-scale environments	
	Individual art object	Individual of species	

Figure 2.8

Community Scale, applied to the art object

Ecosystem conclusions

In conclusion, the power and limitation of the Ecosystem model employed to describe the world is its flexibility. All ecosystem categories and observations are to some degree mental constructions in that they are dependent on the viewer. Whilst some ecosystems may seem obvious and intuitive and exhibit very distinct physical boundaries, such as an island surrounded by sea, others are ambiguous in environmental terms as they are social constructions, (a region), or physically distributed, such as a morphological process, (a river basin). The island is physically occupying space, whilst the morphological processes of erosion, which formed the Grand Canyon, are distributed across millions of years. Thus, although the ecosystem model can describe the tangible 'out there', it can also describe massive processes in massively abstract terms. This is important as both science and art wrestle with the desire to describe the infinite, and things that are so complex that they extend beyond our tools of comprehension. As the philosopher Nicholas Rescher stated, 'As beings with finite physical and intellectual powers we live in a world whose complexity is in fact infinite' (Gross et al., 2011, p. 46). Intuition and entropy convince us though that the world, (and our lifeworld) is not actually random, but as Johannes Schmidt states 'simply extremely complex, which means that the "chaos" is by no means chaotic, but merely a system whose rules are so infinitely complex that no simplifying description is possible' (Gross et al., 2011, p. 46).

This hyper-scale of complexity can only be experienced through a move beyond the classic measurable ecosystem scales and categories, and a turn towards the infinite. Morton describes a form of ecological activity operating at a higher level of abstraction, acting at the global or ecosphere level. He argues that there are things happening at a temporal and spatial scale that are beyond the current methods of systems science and environmental science. He describes these environmental interactions distributed across time and space as 'Hyperobjects', and they can be understood as operating at the level of the hyper-ecosystem. The concept of the Hyperobject does not function as a practical description of the earth but as a new way of shaking things up so that we can think ecologically in a way that transcends the metrics of science. As Morton states, 'Hyperobjects provoke irreductionist thinking, that is, they present us with scalar dilemmas in which ontotheological statements about which thing is the most real (ecosystem, world, environment, or

conversely, individual) become impossible' (Morton, 2013, p. 19). Morton's Hyperobject is then a disruptive tool to describe the ecological state of play in an original way. As he states,

> 'Hyperobjects compel us to think ecologically, and not the other way around. It's not as if some abstract environmental system made us think like this; rather, plutonium, global warming, pollution, and so on, gave rise to ecological thinking. To think otherwise is to confuse the map with the territory.' (2013, p. 48)

He goes on to make an interesting distinction between the descriptive systems employed by science and the actual subjects of science.

> 'For sure, the idea of hyperobjects arose because of quantum-theoretical thinking about the nuclei of atoms and electron orbits (nuclear bombs), and because of systems-theoretical approaches to emergent properties of massive amounts of weather data, and so on. Yet hyperobjects are not the data: they are hyperobjects.' (Morton, 2013, p. 48)

The particular strength of Morton's idea is that he has located a virtual or conceptual space that is not effectively occupied or described by science and has given us a way of apprehending it. Morton gives global warming as an example of a hyperobject, 'When you feel raindrops, you are experiencing climate, in some sense. In particular you are experiencing the climate change known as global warming. But you are never directly experiencing global warming as such' (Morton, 2013, p. 48).

At a practical level, an ecosystem description of an island could quantify the flora and fauna of an island and model the sustainability of various species. Whilst at a more abstract level it can speculate on the wider forces in an operation that may affect the island's ecosystem, such as climate change and wider ecological events. Thus, the ecologist is never seeing a single ecosystem model that represents a place but holds this dynamic picture in the mind's eye, and there is an interesting interplay between this abstract model that operates on different spatial and temporal scales and the tangible island that they can experience affectively. This ecosystem model can equally be applied to the artwork, and the equivalent interplay takes place between the tangible art object and the broader ecosystem description of the work; which captures the invisible forces that generate, sustain and influence the work. The ecosystem model is explored further through a consideration of my art practice in appendix 3, and it is extended in the following chapter through a consideration of the flow of information.

Fold 2

Chapter 3

Information Flow

Chapter 3: Information Flow

Introduction

The biologist and systems thinker Karl Ludwig von Bertalanffy used the German term *Fliessgleichgewicht*, or 'flowing balance' to describe the state of dynamic balance or equilibrium achieved within a system by balancing the flow of material and information through a system (Capra & Luisi, 2014, p. 86). This concept is invoked here, as we consider information flow within information systems and artworks.

There is a dialectical relationship between complex systems such as an ecosystem and the simulations of these systems such as a climate model or information system. The 'out there' world, which can be described as an ecosystem is to some degree a mental construct, and the true nature of it is infinitely complex and unknowable. Thus, the ecosystem is used as a provisional model to describe the unknowable world, whilst the information system is used as a proxy simulation of the ecosystem, and they are influenced by each other. Thus, environmental models and information systems are simulations of the ecosystem, which in turn is a simulation of the unknowable 'thing-in-itself'. There are therefore layers of complexity and layers of removal in any attempt to understand complex interactions in the world. These shifts from the ecological to the informational mark the shift from the primary systems fold to the Open Systems fold.

All models and descriptive systems, in both art and science, are provisional in the sense that we cannot ever know the definitive 'out there' due to the limitation of our senses and knowledge. In Thomas Kuhn's seminal text on scientific thinking, *The Structure of Scientific Revolutions*, (1962) he described how science moved forward provisionally but was always subject to change and paradigmatic shifts. One of the key aspects of this idea was that scientific thinking was not value-free, but was made up of the concepts, methods and values of the scientists, and was therefore to some degree culturally mediated. In particular, the scientist was seen as an active participant in the subject of study. Thus, the scientist will influence both the model of the ecosystem and the materials that flow through a simulation of the ecosystem. This idea is articulated in both thermodynamics and second-order cybernetics as each suggests, in their terms, that the participant, the scientist, is not a removed

and neutral observer, but becomes involved in a wider distribution of influence that affects change. As Lee notes,

> 'Second-order cybernetics rests with the idea that the person who engages the system fundamentally alters it, or perhaps more radically put, constructs it, by virtue of the language used to describe its operations or ask its questions. The system is "autonomous" insofar as it is implicitly "constructed": it is what von Foerster refers to as "cybernetics of cybernetics."' (2006, p. 66)

Thus, in this sense, the scientist or artist mentally constructs the system or simulation to describe the world, and in doing so, the system exhibits emergent qualities that are independent of the original subject, the unknowable world. They are a system to describe a system, which in turn is describing something that is so massive that it is withdrawn from our perception. I would argue that art has evolved to become one of the most flexible tools we have for dealing with such perceptual expanses; as an expanded artwork can span and intersect logic, systems, language, emotions and affectivity and offer us a glimpse behind the curtain to the infinite.

The power of the expanded and distributed artwork was demonstrated early in the history of Systems Art with *Systems Burn-Off X Residual Software*, by Les Levine, which was exhibited in the 1970 exhibition, *Software*. This complex work demonstrated several things simultaneously, including the principle of second-order cybernetics, the emergent qualities of a system, as well as proving that as a culture we are moving away from the material and towards simulation and information. The work consisted of 31000 photographs, which according to the artist and curator Jack Burnham, were 'randomly distributed on the floor and covered with jello; some were stuck to the wall with chewing gum; the rest were for sale' (Shanken, p.2, 1998). Levine highlights something essential in the following statement when he focuses on art being the transmission of information.

> 'the proliferation of mass media was changing knowledge into a second-hand mental experience of simulations and representations i.e. software as opposed to first-hand, direct, corporeal experiences of actual objects, places and events, i.e. hardware. All activities which have no connection with object or material mass are the result of software. Images themselves are hardware. Information about these images is software…The experience of seeing something first hand is no longer of value in a software controlled society, as anything seen through the media carries just as much energy as first hand experience… In the same way, most of the art that is produced

> today ends up as information about art.' (Levine, 1970 cited in Shanken, 2003, p. 434).

Following on from this description we could also imagine how the audience received this work, as they would not necessarily understand this important transition to information in art that Levine is alluding to. Instead, their primary experience is the chaotic materials in the installation and the sensation of entropy in the random distribution of the photographs and the decay of the jello. Thus, these new sensations and messages generated by the work can be described as emergent properties of the system, that may bare little relation to the idea Levine was trying to simulate. This work suggests that there is an interesting space between the things we sense, and how we attempt to describe or simulate them. As Bateson states,

> 'Let us say that truth would mean a precise correspondence between our description and what we describe or between our total network of abstractions and deductions and some total understanding of the outside world. Truth in this sense is not obtainable. And even if we ignore the barriers of coding, the circumstance that our description will be in words or figures or pictures but that what we describe is going to be in flesh and blood and action—even disregarding that hurdle of translation, we shall never be able to claim final knowledge of anything whatsoever'. (Bateson, 1980, p. 27)

Art is more adequately equipped to deal with these ambiguities than science as it is understood within art that the world is unknowably complex and withdrawn from our senses, and so everything we do is ultimately speculative. This acknowledgement of complexity is why artworks require multiple readings, and the space between the information sent and messages received is a critically important aspect of the artwork, when understood as a system. As already noted Marks has usefully employed the Deluzean term of 'unfolding' to describe the way in which an artwork is perceived in a multitude of ways, and this has helped shape my thinking during this research (Vernallis, Herzog, & Richardson, 2015).

There will now be a consideration of the distinction between meaning and information, which draws from the sociologist and philosopher Jean Baudrillard's 'Simulacra and Simulation' (1981). This will lead to a discussion of Shannon and Weaver's classic 'Model of Communication', and a revised model of communication will be proposed that suggests the flow of information through the art system.

Meaning and Information

There is a difference between information and meaning, and the system from which the information is derived is essential in understanding the original meaning of information. For example, if scientific information is received in isolation from the science systems that generated it the original meanings will be lost. The danger of a global temperature increase of 2 degrees is virtually meaningless without the broader science context. The importance of context is also critical in art. If for example, the complex document-based works of the Atlas Group sat outside of the art system the collection of photographs, letters and documents would be read as a personal memorabilia. Likewise the employment of such an 'improbable' collection of materials, according to Umberto Eco, increases the informational content of the work. (Eco & Robey, 1989, p. 54)

Figure 3.1

Walid Raad and the Atlas Group *My Neck is Thinner Than a Hair*, (2003)

Image: Tate (n.d.)

In this section, I draw from Jean Baudrillard's 'Simulacra and Simulation', (1981), and specifically his ideas on meaning concerning Information. Baudrillard was keenly aware of the slippages and potential loss of meaning if information was taken out of context. He stated, for example, 'We live in a world where there is more and more information, and less and less meaning' (Baudrillard, 1994, p. 79).

While this can be demonstrated to be true, the argument in this thesis is somewhat different, as I would argue that new meanings, explicitly in an art context could be generated from the repurposing of information, and the absorption of the material out of their original system and into a new system. The work of the Atlas Group demonstrates this principle as they create fictional documentations from found materials. Thus, such work will contain found photographs, documents and data and these are reconfigured to create new and contradictory narratives that fictionalise both the author and subject. Thus, Baudrillard's statement could be revised to state, 'We live in a world where there is more and more information, and less and less of the original *intended* meaning.' The installation of Breton's studio at *The Centre Pompidou*, Paris illustrates this point, as the original symbolic meanings attached to the carved totems would not have been known to Breton. Instead Breton would have invested these objects with new meanings, and now they are housed in a gallery they have taken on a new status, and new meanings will be attached to the objects by the audience that experiences them.

Figure 3.2

Andre Breton's Wall at the Centre Pompidou

Image: Centre Pompidou, (n.d).

Baudrillard suggested three alternative scenarios for meaning concerning information, and although he is discussing this in a social mass media context, the principles are still instructive in the Contemporary Art context. Firstly he argued, 'information produces meaning.., but cannot make up for the brutal loss of signification in every domain' (Baudrillard, 1994, p. 79). He argues that the repurposing of information and data effectively dilutes the original message as it is fragmented and distributed across media. This was written in 1981, but the Internet and social media have since demonstrated how an excess of media information obscures and transforms the original message. Baudrillard, states,

> 'Everywhere information is thought to produce an accelerated circulation of meaning, a plus value of meaning homologous to the economic one that results from the accelerated rotation of capital. Information is thought to create communication, and even if the waste is enormous, a general consensus would have it that nevertheless, as a whole, there be an excess of meaning, which is redistributed in all the interstices of the social—just as consensus would have it that material production, despite its dysfunctions and irrationalities, opens onto an excess of wealth and social purpose. We are all complicitous in this myth. It is the alpha and omega of our modernity, without which the credibility of our social organization would collapse. Well,

> the fact is that it is collapsing, and for this very reason: because where we think that information produces meaning, the opposite occurs'. (1994, p. 80)

The cultural theorist Raymond Williams suggested that 'any real theory of communication is a theory of community.... It is very difficult to think clearly about communication, because the pattern of our thinking about community is, normally, dominative' (Eldridge, 1981, p. 147). The argument Williams is making is that each communication has a dominant meaning, which emanates from the community in which the communication is taking place. So a colour field painting will generate a different communication to the colour chart of a paint manufacturer, for example. Even if they have the same numerical values for the colour fields present, they are generated from different communities and represent different indexes of information. Figure 3.3 shows three colour field systems, which are based on three different colour systems or communities.

Figure 3.3

Left to right Gerhard Richer, *192 Farben*, 1996, Commercial colour chart, (n.d), Paul Goodfellow, *3 Brethren*, 2014

Baudrillard's second suggestion is that information is a functional process and does not suggest meaning. This idea is based on Shannon's Information Theory, in which the focus is on the quality of the signal, not the message. Here the definition of the information signal is very narrow; Thus, the argument would be that the re-use of this information out with its original system of knowledge would not have a bearing on the meaning. For example, data that demonstrates that Carbon dioxide has increased in the earth's atmosphere from 0.041% to 0.049% is transporting the percentage value change of 0.008%. This information though does not exist in isolation and is therefore also transporting the message that the earth's temperature will increase significantly more than predicted by current climate models. The geographer Swyngedouw (2010, 2013) highlights the danger of reducing this crisis

to the management of numbers. Whilst another geographer, Franklin Ginn suggests the problem of, ‘carbon dioxide has been fetishized to stand in as “the problem,” masking the underlying causes of inequality and politics’ (Ginn, 2015, pp. 351–352). Thus, Shannon's focus on the disaggregation of the signal and noise, to give an accurate Carbon dioxide measurement, does not adequately account for the underlying ecological, or political message. Poverty, for example, cannot be explained by a 0.001% change in atmospheric Carbon dioxide.

Baudrillard's third suggestion is a synthesis of the first two positions and suggests that the circulation and appropriation of information are instrumental in the neutralisation of meaning. Baudrillard suggests information’s exhaustion is related to its destructive function in society, as shared understanding is lost through over circulation of information. (Baudrillard, 1994, p. 81) This neutralisation of meaning was illustrated by Al Gore's famous presentation of the graph that visualised the correlation between the concentration of Carbon dioxide in the atmosphere and global temperature, in the film, *An Inconvenient Truth*, (Guggenheim, 2006). This was a watershed moment concerning the mainstream discussion of global warming, which has had both positive and negative effects in terms of a mass understanding of the information presented. On a positive level, there have been small personal shifts in behaviours, such as an increase in recycling and an understanding of the environmental costs of travel. The familiarity of the information, though, has effectively neutralised the message to such an extent that people cannot imagine the future in any meaningful way. However, this also relates to the issue of scale and abstraction concerning ecosystems. In that, some aspects of our world can be quantified, but climate change is a massive abstraction, which makes us turn uncomfortably towards the infinite. It is a hyperobject, to use Morton’s term, and this cannot be comprehended in informational terms.

Information and Narrative

The narrow information of the atmospheric data discussed here operates very differently to the narrative fictions of the Atlas Group artwork. In isolation, the atmospheric data contains specific information, but little in the way of message. Whereas, the Atlas projects invert the information-to-message ratio in favour of potential, multiple messages and stories. Ecosystems and hyperobjects, such as climate change, which are so massive, that we cannot comprehend them may also be seen in this narrative frame, as they are both systems and stories about systems. Functioning as flexible narrative tools, to grasp things that cannot be readily articulated through specific information. Ecosystems are, however, both informationally rich and have the potential to be narratively rich, through the messages generated at the point of reception.

Thus, the artwork as an ecosystem sits in stark contrast to the predominantly linear narrative works found in mainstream media, which aim to curate the disseminated messages tightly. An example of such a work is the narratively grand, but informationally light film *2012*, about global warming, (Emmerich, 2009), as it offers little space to ruminate on the purported subjects of the film. A complex artwork, in contrast, is rich in information, and is open to interpretation; whilst science is rich in information, but to some degree closed to interpretation. Whereas, a retinal story, such as *2012* is both poor in information, and operationally closed as a system, as it leaves little room to generate new meaning. Swyngedouw argues that such films can neutralise the message through allusion and illusion to technological solutions that may well not exist in reality. He states the following,

> 'The imaginary of crisis and potential collapse produces an ecology of fear, danger and uncertainty while reassuring the 'people' … that the technoscientific and socio-economic elites have the necessary tool-kit to readjust the machine such that things can basically stay as they are'. (2013, p. 10)

Further, it could be argued that such films operate as 'closed' systems, due to their internal logic as they offer little in the way of transferrable meaning. They can be compared to the scientific experiment that takes place in a hermetically sealed bell jar, as it is interesting to observe, but has no application in the wider real-world system. The problem, as noted above by Swyngedouw, is that such films, and other mainstream media, are perversely reassuring, as they do not disrupt our conceptual

or psychic landscapes. They present a ‘crisis’, such as climate change, and then they present a ‘solution’, which effectively masks and neutralises the real danger.

Art, in contrast, should operate differently to this by explicitly opening the system up to noise and complexity. As any message is inevitably disrupted through the process of communication and this should be actively embraced by the artist. Art can do this by disrupting the simple closed system and mixing signal, noise and message into a single work. Thus, a message, should in an art context, be disrupted by something ‘other', such as noise for the recipient to actively engage in decoding. Further, the underlying withdrawn message may not be directly available to the artist as a clean signal due to its complexity, so they must seek to channel it through the noise. As the literary critic Andrew Hageman notes, the strength of such work is ‘not the “explicit ecological programming,” but “their contradictions,” and “the fissures through which we may glimpse and further imagine an ecology without capital – an ecology to come”’ (Ginn, 2015, p. 353)

Thus, art has an important role in disrupting the dominant narratives surrounding complex problems, and ideas, such as climate change. Such narratives range from the reassuring ‘mother earth’ at one extreme to the pornography of the apocalypse at the other. One possible criticism of the original Systems Art movement was its holistic perspective, which encompassed ideas of Gaia and Buddhism and has over time become merged with the wider sixties ‘Whole Earth’ counter-culture. Thus, seen through a contemporary lens, and shorn of the underlying radical systemic thinking the idealism of Systems Art can be misinterpreted as an uncritical and naïve folk religion.

At the other extreme, there is a cold vein of work running through Contemporary Art today that channels the dark ecological thoughts of post-humanism and non-humanism, which at times offers little more than saudade for a lost lifeworld and lamentations for spaceship earth. I would, however, argue that the abdication of the role of the ‘future human' in the world is the ultimate ironic contribution of some of this work, and leaves room within art for a more tangible response. As there is an interesting space between science, which is focused on the moderated signals from earth, and a culture that is dealing with these preconfigured messages of either hope or destruction. As Shannon notes Information consists of signal, message and

noise, and noise is the space between the signal and message. Thus, art should be dealing with the noise, or more accurately be creating sustainable environments or ecosystems in which messages can be developed and decoded through the mixing of noise and signal. As Ginn notes below we should be active participants in the world and the simple messages from each field taken in isolation are limited in value.

> 'We are not spectators of apocalyptic films, we are participants; their ecology an invitation to feel the condition of the Anthropocene and what might lie beyond. If the earth-dreamers watching apocalyptic cinema are parochial, they are no less parochial than the legislators of sound science, the technocrats of earth systems governance, or the salespeople of shiny futures, and their version of the Anthropocene requires scrutiny in good faith, not just dismissal as vicarious indulgence or post-political passivity'. (2015, p. 359)

Thus, the changes emerging within the planetary system and the changes within the psychic systems cannot be easily communicated due to their infinite complexity. Science cannot measure the infinite, and stories with a singular arc cannot express a multicursal future. Art then must reflect the condition of the Anthropocene, and this is through the addition of complexity, and in particular the addition of noise into the debate.

Thus, what is noise? Noise within an art context can be two things. Firstly it can be the conscious disruption of a signal, and this will force the viewer to more fully engage with the signal to decode the message. If the work is too literal, such as the depiction of a melting iceberg to denote climate change, there is nothing to decode and the viewer will not be engaged in the message. Secondly, the noise is not noise at all but is in-fact a signal that is being transported by the artwork, even though the artist is unaware of the message contained within this noise-signal. The artist is channelling the message, and they may only discover the message themselves through the production of the work. This is demonstrated in the strategies of abstraction and repetition, as the artist works at unearthing underlying structures within a narrow band of material and process. Likewise, *SETI*, (*Search for Extra-terrestrial Intelligence*) research programme use radio telescopes to listen for narrow-bandwidth radio signals from space. Such signals are not known to occur 'in nature', so detection would provide evidence of extra-terrestrial technology. (SETI, 2017) Thus, within this 'white noise' there may be signals that we have not yet classified as signals. Within physics, telecommunications and music 'white noise' is understood as completely random and consequently contains no message. The

messages, though, may be there, just much more deeply hidden than we can currently imagine. As Sha Xin-Wei notes,

> ‘Random is another name for our ignorance, our inadequate senses, and, in the computational setting, the sparseness of our reach. Noise, for me, is not just the random in space, or time, or shape, but the hovering of patterned material (matter, energy, symbol, affective field) at the limit of measurement, and therefore observation’. (Vernallis, Herzog, & Richardson, 2015, p. 104)

Marks, notes the potential psychological danger in sifting through the infinity of unknown signals, (noise), for messages, as we are adapted to filter out noise as a function of survival. Noting that, schizophrenics often detect patterns and relationships that indeed exist but that other people's brains block out. (Vernallis, Herzog, & Richardson, 2015, p. 105) This may explain why there is an underlying torment in art practices, which channel noise and abstraction, captured in the paintings of Mark Rothko, or the performances of La Monte Young. Such practices, particularly the work of Young, operate at the boundary between extreme pleasure and pain and these can therefore also be understood in affective terms. I am very drawn to the work of Young, Yoshi Wada and Sunn O))) as their systemic approaches structure time giving the listener space to disaggregate the noise and signals.

There is, though, a cultural, or strategic aspect of the employment of noise within art. As Baudrillard noted, messages contained within information can be exhausted through over circulation. This can be seen through the over circulation of messages in social media so that an idea is reduced to a meme, or in film where global catastrophe is averted: deus ex machina. As Mark Fisher notes, ‘Environmental catastrophe features in late capitalist culture only as a kind of simulacra, its implications for capitalism too traumatic to be assimilated into the system’ (Fisher, 2009, p. 18). Likewise, it can be seen in the constant re-use of the same tropes in Contemporary Art. Potted houseplants or slime, for example, denote our alienation from nature, while over-stacked shopping carts perform the material complexity of Late Capital and frame-within-frame digital images demonstrate media’s recursive autopoietic nature. The clarity of these messages conforms to the notion that communication should be ‘maximally clear’, and this is the underlying principle of advertising and graphic design. Whereas art, which foregrounds the disruption of the signal through the introduction of noise, could according to Marks, ‘be the

definition of art in the Information Age' (Vernallis, Herzog, & Richardson, 2015, p. 108)

The Flow of Information

Thus, two critical points were noted in the previous section concerning the complex artwork in the information age. Firstly, it may be impossible for an artist to know what is signal and what is noise. Thus, the role of the artist is to channel the signal-noise material to the audience, who may be able to disaggregate and decode the message. Secondly, where the truth of the message is getting lost through over circulation the role of the artist is to add noise to the signal, so that the audience must work to receive the message. These thoughts shift our understanding of the artwork from being a physical object to being an information carrier, transporting signals and noise from the artist and to the audience.

Thus, thinking of the artwork in informational terms is a useful addition to the concept of the ecosystem, which describes the ecological environment of the artwork, how things have grown, how they are sustained, and how it operates on an abstract level across different objects and processes. Whereas thinking about the artwork in informational terms allows the artist to model how various forms of information and experience flow through the work and out to the audience and back to the artist.

This is, though, a complicated process as not only is it difficult to disaggregate between signal and noise, and message and randomness, the very notion of information, including its authorship and provenance within an artwork is extremely difficult to pin down. Even from a relatively narrow Information Theory perspective information has proved elusive as a concept, as Shannon noted,

> ‘The word ‘information' has been given different meanings by various writers in the general field of information theory. It is likely that at least a number of these will prove sufficiently useful in certain applications to deserve further study and permanent recognition. It is hardly to be expected that a single concept of information would satisfactorily account for the numerous possible applications of this general field, (italics added)' (Shannon & Weaver, 1963, p. 180)

It is interesting that Shannon and Weaver's *Mathematical Theory of Communication*, (1948) predates Baudrillard's original French edition of *Simulacra and Simulation*, (1981) by 43 years, but there is an underlying structural similarity between the two texts. Both theories have a structural analysis of Information and a semiotic analysis of information. The difference is that the structural analysis is the

main focus of Shannon and Weaver, whereas the semiotic analysis is the focus of Baudrillard. This is made apparent in Baudrillard's text, as he switches the order of the structural and semiotic perspectives, as compared to Shannon and Weaver's text. Both texts also offer a third way of understanding information concerning synthesis and the application of their ideas, but it can be argued that Shannon and Weaver's text is important for the formal analysis of information while Baudrillard's for the semiotic analysis.

Thus, Shannon and Weaver's model of communication will now be introduced as the foundational model of how information flows through a system. The contention is made that the primary flows of information can be modelled in a complex information system, but the actual meanings being transported through the system cannot be formalised. The rationality for the ambiguity of meaning flowing through the complex is derived from philosopher Jacques Derrida and his revisions of Ferdinand de Saussure's *Course in General Linguistics*, (Saussure, 1990) and Saussure's concern for the meaning of language. As Derrida revises Saussure position and argues that the relationship between signs are inherently unstable, as 'meaning is constituted by a system of differences' (Cilliers, 1998, p. 37).

Shannon and Weaver's Model of Communication is a simplified and technologically driven description of how communication happens and meanings are circulated in information systems. Thus, it is presented here not as a contemporary take on information theory, but more as an analogical tool to allow the artist and audience to imagine the complex flows of information and influence that are drawn upon at both conscious and unconscious levels in the production and reception of an artwork. This model is given further structure through the consideration of information types, and these are discussed in Appendix 2.

Shannon and Weaver's *Model of Communication* was revolutionary at the time of its inception, as it articulated the role of information and drew directly from cybernetics. The *Model of Communication* can be described as a 'transmission model', and has its roots in the metaphor of transportation of material. Carey, in *Communication as Culture*, (1981), located this idea as, 'a view of communication that derives from one of the most ancient of human dreams: the desire to increase the speed and effect of messages as they travel in space'. (Carey & Adam, 1988,

p. 15) So whether the transportation was of coal, food or people on one level or the text transporting meaning to readers on another, there was a definite delivery of some sort.

The postal system is often put forward as the emblematic metaphor of communication as a transport system, as it consists of the production, distribution and reception of messages in the form of letters. (Carey & Adam, 1988) In this model, the key actors are the letter writer, the reader, and the delivery system that facilitates this, such as the network of post boxes, the postal staff and the wider infrastructure. This model does not have anything to say about the content of the letters or the wider postal service as it pertains to society. Rather it is a very narrow definition of signal transmission, and as such captures the essence of Shannon and Weaver's *Model of Communication*.

This model, generalised here, can be understood as a tool to understand and map the flow of information through a system, including an artwork. Information starts with the source, encoded by someone or something and the message is transported in some form. During transportation, the message may be disrupted by noise, before being decoded by someone or something, and then absorbed by the recipient. The flow of information is illustrated below, (figure 3.4), whilst each node is summarised in figure 3.5.

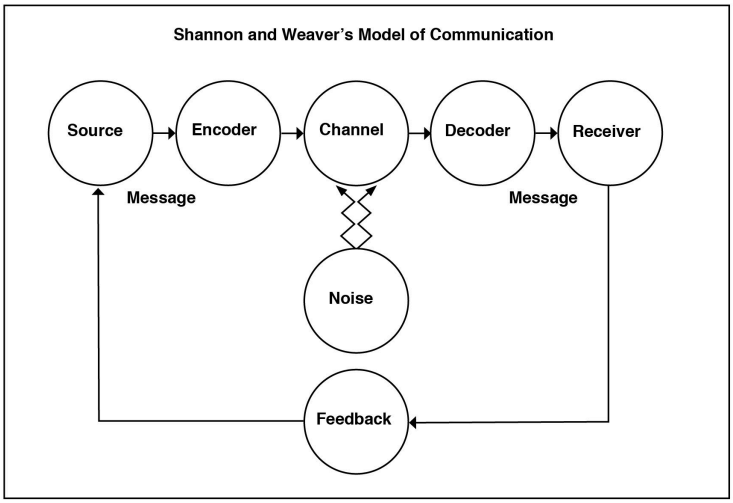


Figure 3.4

Based on Shannon and Weaver's Model of Communication (1963)

Node	Description
Sender	This is the information source and the sender is the person, system, or device that generates the message. The designer of the communication will at this stage choose the channel through which the message is sent.
Encoder/Transmitter	The Transmitter or encoder is the sender who uses the system to convert the message into an appropriate signal.
Channel	The channel is the method or technology employed to send message.
Decoder/ Destination	Destination or receiver is the person who gets the message and decodes the message. This can also represent a stage between the channel and the final recipient. The decoder will provide feedback to the sender of the message.
Noise	Noise is the disruptions to the signal from external factors, due to technical issues in delivery, or the unintentional addition of unwanted information.
Receiver/ Destination	The Receiver, (destination) is intended recipient of the message, and they will provide feedback to the sender regarding the message they have received.
Feedback	Feedback in this process allows the sender to adjust the delivery of the message to make the intended meaning clearer.

Figure 3.5

Shannon and Weaver's Model of Communication, (1948)

Shannon and Weaver's Model of Communication can be revised to consider the flow of information through an art system, as seen in figure 3.6. In this revised version information starts with the 'Information source', and this is the information type consciously or unconsciously selected by the artist, and the information categories discussed earlier, can help locate these. The 'Transmitter' denotes the translation of this information into material by the artist, which will create new information. The 'Channel' is the selection of vehicle for the transmission of this information, the art object or performance and this will have a dialectical relationship with the information. Delivering the message through performance, film, or installation will invariably change what is relayed. This is in part, due to the introduction of noise into the transmission of information, and while noise can be introduced at any time during the communication process, it will be carried through the channel, (the artwork). The heat and sounds during a performance, for example,

may be unintentional, or less controllable additions to the work, but they could also profoundly mutate the work's reception. The degree of distortion and noise the artist wishes to introduce into the system depends, in part on the degree to which they understand the original message, and whether that message is worth circulating.

The Flow of Information in an art system	
Node	**Description**
Information source	This is the information type selected by the artist. Source material for artist. See Appendix 2 for a discussion of the information categories.
Encoder/Transmitter	Translation by the artist into material, (which will create a new information type).
Channel	Channel the choice of using art, conceptual art etc., and this has a dialectical relationship between the information types.
Decoder	Receiver is the person who gets the message or the place where the message must reach. The receiver provides feedback according to the message. Thus, this will be the audience or the Gallery, and the decoder may specifically be the curator, who in turn offers feedback to the artist.
Noise	Noise operates at all times, but mainly at the channel stages. Noise may be disrupting the original signal. So the original message time is not getting through. An expanded version of the Shannon-Weaver model that acknowledges the noise at the encoding/decoding and reception stages of the system can be applied to Information Systems, and to the art system-object.
Receiver The audience	Receiver is the person who gets the message, and the original message of the artist may, at this stage, have been mediated by the decoding process of the curator or gallery. The receiver provides feedback according to the message.
Feedback	Feedback is from the gallery, curator, audience, media and critics

Figure 3.6

Revised Model of Communication: The Flow of Information in an art system

This way of thinking of the artwork is very useful as it allows art to be disaggregated along the lines of the intentions of the artist and audience. If, for example, the artist has a very clear message and they want to send this message intact to a very specific audience, they will select an appropriate channel, (type of work). Thus, to

understand this simple flow of information-message the artist needs to explicitly know the key actors for each stage of the information cycle. They need to know their intended audience and the types of message this audience wants, (or needs) to receive and the form they wish, (or need) to receive them, and the level at which they want, (or need) to 'work' to decode them. Thus, if an artist wants to appeal to the commercial art market, they must consider what messages this market wishes to buy and in what form they want them packaged. Likewise, they must understand the degree of mental investment this audience is prepared to make, even vicariously through the gallerist, concerning decoding the work. If the work is too easily read, in message terms, then the audience will not be interested in the channel, (the work) as it will not be able to perform its wider social role of demonstrating the intelligence, wealth or social cache of its new owner. Thus, such a cynical employment of art requires strong feedback mechanisms so that the artist can understand and deliver artworks that embody the optimum level of complexity and noise, whilst packaged in the right level of spectacle and luxury.

This balancing act is most keenly demonstrated in the work and career of Damien Hirst, as initially, the art market was very pleased to sponsor his parodic, but highly finished appropriations of conceptual and Systems Art, as they operated at the right informational level for their audience. However, his work was quickly exhausted through over circulation and the curators and gallerists tasked with keeping the art market stable as a system, sought to recalibrate the market's relation to his work. Seen from a meta-art market level Hirst's legacy or contribution to the art discourse may not be the specific art objects he authenticated, but the way his transactions revealed the role of Late Capital in mutating the art system.

In contrast the serious artist should find the employment of this model a useful tool, as it will give them a stable framework to model the flow of materials, and information in their work. This simplified model of information flow is applied to my art practice in the 'Withdrawn Fold', (appendix 3). Several forms of systems based art are discussed in this practice fold and these are illustrated with examples of work. Firstly, there are rule-based works, and the processes of feedback and emergence are demonstrated. Secondly, more complex work, which can be understood as ecosystems are discussed and illustrated with several examples. Finally, works, which do not fall directly within these categories, are introduced as they emerged

within my studio practice and forced an expansion of my systems thinking. This extension of my system thinking is contextualised in the following chapter, which considers how systems have enfolded culture in the past two decades.

Chapter 4

Enfolding Systems

Chapter 4: Enfolding Systems

Figure 4.1

Folds of Limestone, Sandstone, Shale and Siltstone
Boulmer, Northumberland, 24th January 2018

The concept of the folds employed in the thesis corresponds to how we experience systems on an individual and cultural level. The Open System fold, (1980-2001), had the embedded suggestion that we were moving towards a flat ontology within culture in which multiple non-linear readings operate.

Whilst folds, as applied to the thesis creates an appealing flexibility and allows arguments to be unfolded through time rather than dominated by time. As noted in the introduction to the thesis I have observed three folds in our cultural and personal relationship with systems, and I have organised this doctoral project to both reflect upon these folds and morphologically reflect the structure of these folds. Thus, the first fold of my doctoral project, chapters 1 and 2 considered the emergence of holistic systems thinking, and in particular the concept of the ecosystem. While the second fold saw the shift from systems models of the world, such as the ecosystem to a focus on information about these systems. This shift in emphasis, described in the previous chapter, marks the discussion of the Open Systems fold and an attitude of openness in two senses. Firstly it is a positive acknowledgement of the openness that technology and information afford within society. Secondly, it is an acknowledgement that such openness demands multiple textual readings of things.

As noted both the holistic model of the ‘ecosystem' and the open model ‘information flow' have been used to consider my art practice, and this is documented in

Appendix 3. Although useful in their ability to describe the work and its operation the review concludes with the work Remotely Sensed, (2014), and the 'constructed' paintings (2016-2018), which disrupt the simple ecosystem-information model. This disruption forces a deeper consideration of how system thinking has unfolded over time and what can be introduced to add flexibility to the systems description of the artwork.

The concept of the ecosystem was widely established in the 1960s and the concepts surrounding information and information systems became commonly employed in the 1980s. Both areas have a strong cybernetic or systemic foundation, which they share with Systems Art and I owe a strong intellectual, and emotional debt to the original Systemic Artists and writers, such as Roy Ascott, Jack Burnham and Robert Smithson, for the clarity of their writing and practice that has helped shape my thinking.

Systems thinking had a long period of germination within cybernetics, biology, and military thinking before it unfolded within culture in the 1960s. It was only when cybernetics started to fully acknowledge the participants within the system that it can be said to have culturally unfolded. Thus, the trajectory of systems in terms of folds can be approximately mapped against the progression of cybernetics as follows.

First-order cybernetics can be understood as developing from the 1940s, through to the early 1960s. During this period ideas such as homeostatic balance and feedback within biological systems, and signal and noise in information systems emerged. These ideas were built on Alexander Bogdanov's organisational concepts of *Tektology*, and Ludwig von Bertalanffy's *General Systems Theory*, which he described as 'a general science of "wholeness"' Bertalanffy' (1968, p. 37). As discussed in the earlier chapters one of underlying principles of 'first-order cybernetics' was system balance through the exchange of materials in physical systems, or the exchange of information in cybernetic systems. During the first phase theorists already discussed, such as Norbert Wiener, Claude Shannon, and Gregory Bateson, built on Bertalanffy's General Systems Theory. Shannon and Wiener reconfigured the systemic ideas of control systems found in both machines and the organism to develop Information Science.

The primary distinction between this first-order cybernetics and second-order cybernetics is the way they understood the process of observation within the system. In first-order cybernetics, the systems were conceived as if the observer was external to that system. As Luhmann noted, 'The first-order observer concentrates on what he observes, experiences, and acts out within a horizon of relatively sparse information' (Luhmann, 2000, p. 64); whereas, second-order cybernetics acknowledged the observer of a system as an active participant in the system.

Historically second-order cybernetics corresponds to the first fold of systems envisaged here and covers the period between 1960 and 1980. The second order was built on the work of Von Foerster, in which he found Bertalanffy's *General System Theory* problematic, as the homeostatic system did not take account of the observer. Thus, the second-order marked a shift in thinking as the observer became implicated in the systems they observed. As Lee notes,

> 'Second-order cybernetics rests with the idea that the person who engages the system fundamentally alters it, or perhaps more radically put, constructs it, by virtue of the language used to describe its operations or ask its questions.' (2006, p. 66)

Katherine Hayles suggests that Second-order cybernetics reached its apotheosis in the work of Humberto Maturana and Francisco Varela's, and in particular *Autopoiesis and Cognition: The Realization of the Living* (1979), which she described as cybernetics' 'reflexive turn'. Hayles summarised Maturana and Varela's position as follows,

> 'Organisms respond to their environment in ways determined by their internal self-organization. Their one and only goal is continually to produce and reproduce the organization that defines them as systems. Hence, they not only are self-organizing but also are autopoietic, or self making'. (1999, p. 10)

The concept of autopoiesis, or 'self making' underpins the second wave, and Maturana argued that there is an underlying circular reinforcement at work within biological systems, stating,

> 'The living organization is a circular organization which secures the production or maintenance of the components that specify it in such a

> manner that the product of their functioning is the very same organization that produces them' (Maturana cited in Hayles, 1999, p. 138)

That is, the essential person or organism remains the same entity throughout its existence, and despite cellular changes or external circumstances, the underlying structure remains the same. This advancement on the informational Fliessgleichgewicht view of cybernetics was seen as a requirement to explain biological life in systems terms. In particular, if an organism is understood as a system then there is a dialectical relationship between the cell, (system), and body (system). Maturana described this interdependence as 'structural coupling'. The advancement Maturana made in terms of these interdependent relationships is how we position our observation of them, and the degree to which we construct them in our minds. As Hayles notes,

> 'Information, coding, and teleology are inferences drawn by an observer rather than qualities intrinsic to autopoietic processes. In the autopoietic account, there are no messages circulating in feedback loops, or are there even any genetic codes. These are abstractions invented by the observer to explain what is seen; they exist in the observer's "domain of interactions" rather than in autopoiesis itself.' (1999, p. 138)

That is, the systems we develop are products of the mind, and are ways of explaining what we observe. We are not observing those systems, external to us; rather the information we elicit from a cybernetic, ecosystem, or art system is relative to that system, and us. The infinite 'out there' remains removed from these models. As Maturana states, 'the notion of information refers to the observer's degree of uncertainty in his behavior within a domain of alternatives defined by him, hence the notion of information only applies within his cognitive domain' (Hayles, 1999, p. 139).

Thus, as Hayles notes, 'the act of observation necessarily entails reflexivity', (Hayles, 1999, p. 138), and this realisation corresponded with other developments within the 1960s as wider culture turned towards systems. The three waves of cybernetics can be understood in terms of 'balance', (first order cybernetics), 1940-1960, in terms of 'reflexivity', (second-order cybernetics), 1960-1980, and finally the shift to the virtual, or 'Virtuality', (Hayles, 1999, p. 16). In contrast, the three folds can be understood as follows. The Primary Systems fold, is a period of primary engagement with ideas of the system. The Open Systems fold critically extends and

deconstructs our relationship with systems. Finally, the Post System, in which culture and self are enfolded and lost within systems. This is the narrative trajectory unfurled in this chapter.

The first fold describes systems as they were first unfolded to wider culture during the 1960s and 1970s, which saw the growth in ecological awareness, holistic thinking and Systems Art. Each of these movements employed systems thinking as a way of speculating on the future. Systems Art accommodated both optimistic and critical readings of systems within art. The optimistic, or to some degree uncritical view was typified by *Cybernetic Serendipity*, the 1968 exhibition curated by Reichardt at the *Institute of Contemporary Art*, (ICA). Reichardt described Cybernetic Serendipity in the catalogue as dealing with the

> 'possibilities rather than achievements, and in this sense, it is prematurely optimistic. There are no heroic claims to be made because computers have so far neither revolutionized music, nor art, nor poetry, in the same way that they have revolutionized science.' (Cited in Quaranta, 2013, p.51)

Whereas the Jack Burnham curated exhibition, *Software*, (1971) which was held three years later had a more nuanced and critical understanding of systems that considered the underlying processes. In the catalogue, Burnham defined the aim of the exhibition was 'to focus our sensibilities on the fastest growing area in this culture: information processing systems and their devices' (Burnham, 1971, p.10). Burnham stated that in,

> 'the past few years, the movement away from art objects has been precipitated by concerns with natural and man-made systems, processes, ecological relationships, and the philosophical-linguistic involvement of Conceptual Art. All of these interests deal with art, which is transactional; they deal with the underlying structures of communications or energy exchanges instead of abstract appearances. (1971, p.10)

The Primary fold to some degree 'closed' towards the end of the 1970s, and this was replicated in environmental thinking, which had been built on the cooperative model of Odum's ecosystem and it heralded a turn towards the selfish gene and a new era of evolutionary driven competitiveness. Thus, as ecology turned towards natural selection, so art, now fully shorn of the grand narratives of Modernism turned to a form of market-driven individualism. Thus, the selfish gene was a concept that could describe the demise of many of the principled developments of the 1960s as

culture entered the 1980s. These ideas were not lost, though, as artists who had come of age during the 1960s were now teaching in art schools, and they started to influence a new generation of artists to reconsider systems. This new generation rediscovered systems thinking and the clarity that it afforded, by revisiting the work of the first generation of Systems Artists. In a sense, the new generation of Systems Artists were picking up messages embedded in the signals of the original Systems Art.

This increased interest in systems within art could be seen within the work of a whole range of artists during this period of the Open fold. Some artists directly mined the work and ideas from the first generation of artists to produce new work. Damien Hirst, for example, reworked many of Hans Haacke's original environmental systems works, with *Loving in a World of Desire*, (Hirst, 1995), operating as an ironic simulation of Haacke's Floating Sphere, (1964). This repurposing of Haacke's work used the structure of the original work to overlay a simple colour field system, but in the process, the clarity of the original intention of the work was lost. This loss alludes to Baudrillard's argument that ideas re-circulated lose their original message. Hirst's work was typical of the early returns to systems, as they were reading the works in a relatively surface way as source material. Thus, the physically present material object, and not the underlying system became the dominant art experience during this period, as they served the diverse roles of marketable commodity and basis for textual discourse.

Other artists who emerged in this period started to dig a little deeper into the underlying systems ideas inherent in the original work. These included Seth Price, Olafur Eliasson, and Tauba Auerbach who employed systems at the level of organisation and production. Whilst artists such as Liam Gillick, Pierre Huyghe, Philippe Parreno and Tino Sehgal, used systems thinking as part of a broader social and political analysis of society. Their work, sometimes described as the 'Relational Turn', was driven in part by the Relational Aesthetics of Nicolas Bourriaud's and his influential book *Relational Aesthetics*, (1998), alongside and Alfred Gell's *Art and Agency* (1998). These works can be traced back to the institutional critique developed in Arthur Danto's essay *The Artworld*, (1964), in which the focus shifted from the art objects to the systems operating within art. Also to Pierre Bourdieu's *Field Theory* and its analysis of the systemic relationship operating at different

scales within society. This approach can also be traced back to Jack Burnham, and his influential Artforum essay *Systems Esthetics*, in which he described art as being freed from the art object and operating as a 'social act' (Burnham, 1968).

In addition to these generational echoes and ripples from first generation artists, two other major developments took place within culture during the Open fold. Firstly the promises of technology, afforded by cybernetics and computing in the 1960s became a reality in the 1980s and 1990s. Secondly, the shift from object to relations and from author to reader created by Conceptual Art, Post-structuralism and Post-Modernism became the dominant cultural discourse. The Open Systems thus corresponded to the 'open artwork', which Umberto Eco described as,

> 'Open in that it proposes a wider range of interpretive possibilities, a configuration of stimuli whose substantial indeterminacy allows for a number of possible readings, a "constellation" of elements that lend themselves to all sorts of reciprocal relationships'.(1989, p. 84)

There was an interesting confluence between these seemingly disparate areas of technology and culture during the Open fold, as both contributed to the destabilisation of authorship. In technology the role of databases, Hypertext and the Internet allowed the reader to access information in ways that could not be envisaged by the original authors; whilst Barthes, Derrida and Eco had philosophically performed the same operation of liberating the text from singular readings. As Nelson's *Hypertext* and Barthes *Literary Machine* are surprisingly similar in function, as Landow notes,

> 'When designers of computer software examine the pages of 'Glas' or 'Of Grammatology', they encounter a digitalized, hypertextual Derrida; and when literary theorists examine 'Literary Machines', they encounter a deconstructionist or poststructuralist Nelson. These shocks of recognition can occur because over the past several decades literary theory and computer hypertext, apparently unconnected areas of inquiry, have increasingly converged'. (1992, p. 2)

I experienced this openness directly, initially from the technological perspective and its employment in information systems and the manipulation of data. I had been educated in the late 1980s within a quite idealistic framework that understood the world in cooperative and holistic ecosystem terms. Whilst in the early 1990s my interest in the environment had started to shift from the material 'out there', to its' simulation and the flow of information.

In retrospect, I understand my early enthusiasm for simulation over reality, was not so much a rejection of the material world, (as my research required grounding in the earth), but it was the break with the singular narrative that technology and systems thinking afforded. Technology gave a sense of individual empowerment during the Open Systems fold, as opposed to cooperative empowerment of the group in the first fold. This technological 'Glasnost' was initially seen as a positive expansion of individual freedom, as captured in the 1994 edition of ecological and systems bible, the *Whole Earth* catalogue. It opened with a quote from Stewart Brand, from the original 1968 edition, that captures the sense of opportunity that technology affords.

> 'We are as gods and might as well get good at it. So far, remotely done power and glory as via government, big business, formal education, church has succeeded to the point where gross defects obscure actual gains. In response to this dilemma and to these gains a realm of intimate, personal power is developing power of the individual to conduct his own education, find his own inspiration, shape his own environment, and share his adventure with whoever is interested.' (Rheingold, 1995, p. 1)

The effective difference between the tone of the 1960s catalogue and the 1990s version is that the original catalogues had an ecological systems view of the earth and getting 'back to the land', whereas the 1990s version was a systems view of a world that was being extended by cyberspace. This technological optimism chimed with the political and social naivety of this period, which was captured in 1992 book Francis Fukuyama's, *The End of History*,

> 'What we may be witnessing is not just the end of the Cold War, or the passing of a particular period of post-war history, but the end of history as such: that is, the end point of mankind's ideological evolution and the universalization of Western liberal democracy as the final form of human government.' (Fukuyama, 1992, p. 1)

In a sense, Fukuyama's book was the swansong of a particular way of thinking, which, Franco Berardi described as the expectation of 'progressive modernity'. He observed,

> 'These expectations were shaped in the conceptual frameworks of an ever progressing development, albeit through different methodologies: the Hegel-Marxist mythology of *Aufliebung* and founding of the new totality of Communism; the bourgeois mythology of a linear development of welfare and democracy; the technocratic mythology of the all-encompassing power of scientific knowledge; and so on'. (Fisher, 2014, pp. 6–7)

Fukuyama was wrong in his analysis of the favourable endgame of democracy and Capital, but his book captured the popular misguided belief that things were not only getting better', but getting simpler, (in narrative terms). They did not get simpler, as we ended this era reading the *Infinite Jest*, David Foster Wallace's multifaceted novel, (1997), and being immersed in the complex installations of Jason Rhoades, such as the Creation Myth, (1998) which demonstrated things were only ever going to get more complex. The *Infinite Jest* anticipated narrative non-linearity, a condition that the system world both affords and demands. Whilst the Creation Myth morphologically demonstrated the complexity of systems and hinted at ways in which art could subvert systems through the introduction of noise.

Figure 4.2

Jason Rhoades
The Creation Myth 1998/2015
Installation view.
BALTIC Centre for Contemporary Art, Gateshead, UK
Friedrich Christian Flick Collection, Berlin.
Photo: Colin Davison

The Primary fold introduced systems into culture and we reflected upon their utility, and the systems concept extended our understanding of the holistic nature of the world and our place within in. Systems unfolded and helped explain our relation to nature, our communities and our productive tools, such as art. Whilst the Open fold allowed us to further understand the power of systems on both a technological and critical level. These digital and mental tools afforded individual freedoms to operate within systems, and the decoupling of the author from the text. We felt empowered,

both technologically and critically; but as we absorbed and remixed the images and texts of others, we too were being absorbed.

As something happened during the Open fold and this can be seen as an insidious emergent quality of the systems in operation. As more people engaged with systems-based processes, such as databases, and the Internet, the experience transmogrified from unfolding systems to enfolding systems. That is, the tools that had originally been designed to decouple the author from the text and allow freedom of navigation had autopoietically 'structurally coupled' the participants to the system. In the same way that Maturana described the interdependence of cells to the body, so the individual has been structurally coupled within the dominant systems of society. This change in relationship marks the third and final systems fold in which we become enfolded and engulfed within systems we cannot control at the individual cellular level.

Thus, at the close of the millennium, our place within systems inexorably shifted from dominant actor to dominated participant. This story has of course been repeatedly told to us in contemporary culture, as if someone wished to diminish its power through repetition. The film *The Matrix* is probably the most direct exhortation of this message and it was released at the end of openness in 1999, whilst other films have suggested our enfoldment in more oblique terms, such as Stanislaw Lem's *Solaris*, (1972). Whilst other contemporary narratives, such as the *Stranger Things* television series (2016-2017) sense we have lost something in the transition to the new millennium, but can't quite place it. This show is a rich remix of popular culture from the period undercut with the feeling of saudade for a time when our primary fears were tangibly alien. Fredrick Jameson describes such Polaroid filtered revisionism as the 'nostalgia mode', and it operates quite differently to forward-looking culture, such as Herbert George Wells' *War of the Worlds* (1898). Folding time by one hundred years recasts the opening paragraph of this novel as a coded message about the rise of intelligent systems.

> No one would have believed in the last years of the ~~nineteenth~~ (*twentieth*) century that this world was being watched keenly and closely by intelligences greater than man's…that as men busied themselves about their various concerns they were scrutinised and studied, perhaps almost as narrowly as a man with a microscope might scrutinise the transient creatures that swarm and multiply in a drop of water. With infinite complacency men went to and fro over this globe about their little affairs, serene in their

> assurance of their empire over matter. ..Yet across the gulf of space, minds that are to our minds as ours are to those of the beasts that perish, intellects vast and cool and unsympathetic, regarded this earth with envious eyes, and slowly and surely drew their plans against us. And early in the ~~twentieth~~ (*twenty-first century*) came the great disillusionment. (Wells, 2017, p. 9)

Thus, the period of relative innocence and openness with and towards systems ended with the literal shocks to the system of the 'millennium bug', the 'dot.com' financial crash, and '9/11', and suddenly we were enfolded within systems, in ways we had not anticipated. These shocks made us aware of the increasing complexity and potential instability of its operations. Bertalanffy noted that open systems could temporarily operate against the second law of thermodynamics and retain structure through an increase in complexity. He gave the example of organisms maintaining themselves in a steady state through an increase in complexity. Bertalanffy stated.

> 'In open systems, however, we have not only production of entropy due to irreversible processes, but also import of entropy which may well be negative. This is the case in the living organism which imports complex molecules high in free energy. Thus,, living systems, maintaining themselves in a steady state, can avoid the increase of entropy, and may even develop towards states of increased order and organization.'(Spradlin & Porterfield, 1984, p. 192)

Whilst Carl Zimmer observed that the principle of increasing complexity is also an aspect of biological evolution. He notes that on a biological level a mutation towards complexity will either give the organism an evolutionary advantage and it will be carried forward, or it will have a negative effect, and the mutation will die out. He suggests, though, a third option in which the complex mutation has a neutral effect, and it is therefore carried forward, as a sleeping agent for future complexity. (Zimmer, 2013, pp. 84–89)

This idea of complex mutation, which lies dormant, but will be an agent of future complexity and diversity, can be directly applied when considering systems within art and critical thinking. Jack Burnham's writing, for example, feels uncannily prescient and Jones suggests, it was explicitly addressed to the future, (Burnham et al., 2015, p. xiii). His writing on Systems anticipates the complexities, opportunities and dangers of a world dominated by systems, and he neatly foreshadows the condition of the Post-Systems condition. Whilst his later writing, from 1972 onward, demonstrates even more starkly this sleeping agent quality

fusing elements of Systems Thinking, Kabbalah and ritual. This is evidenced in several articles in Arts magazine, including *Duchamp's Bride Stripped Bare* (1972), *The Semiotics of End-Game Art* (1972), *Objects and Ritual* (1973), and *Ritual and Art* (1973), all of which suggest an esoteric route through complexity (Ragain cited in Burnham et al., 2015, p. xiii). This 'mystical turn' has been largely excluded from art history narratives, but it is an important development of his systems thinking and is congruent with forms of animism, mysticism, Buddhism and Hinduism, which see a oneness or infinity as the endgame of searching through complexity. As Ragain contends,

> 'Comprehension (..) requires that historians no longer efface the mystical turn of Burnham's later career and that we instead address it as an extension of the self-organizing and determining nature of systems and their not-so-distant relation to historical notions of "spirit" or "mind." (Burnham et al., 2015, p. xiii)

This idea of the sleeping store of mutation and complexity is most profoundly demonstrated in the writing of Gilles Deleuze and Félix Guattari, and in particular *A Thousand Plateaus* (1980). This complex and at times esoteric text was published in the first year of the Open fold, but is still offering revelations and will be drawn upon in the next chapter to extend the conception of a contemporary systems-based art.

As noted earlier, during the 1990s I had worked on complex environmental projects in the manipulation of complex information and satellite images to demonstrate potential relationships between morphological processes and social factors present within the data. I tended though to stray from the 'correct' rule-based methodology of manipulating images to a more intuitive and spontaneous method. Thus, this approach was an oscillation between the rigour of rules, (akin to the Conceptual artist), and the rigour of material affect, (akin to the Abstract Expressionist). This approach created fascinating results and demonstrated relationships within the data that could not be verified by using standard methods. This is because I had evolved a mutated methodology and perspective, which could not be contained within a strictly scientific context. This mutation has remained within me, acting as a sleeping agent for future complexity within my art practice.

Unable to reconcile the meanings I was eliciting from my environmental work with the systems and methods being employed. I moved from working on an environmental research project in Colombia to a two-year art residency at Imperial College, (1996-1998), with the plan to reconsider the emergent mutations within the ecological work. I found, though, as the first resident artist at the College I inadvertently had to take the position of Contemporary Art apologist within this formidable science community. Thus, in retrospect, I understand that I was drawing more from a sociological application of systems during this period as I attempted to understand the distinctions I wished to draw from my systems activity and those demonstrated within science. This position of institutional critique led to several exhibitions and seminars, including work such as *The Divided Self*, (figure 4.3) in which I mapped how science and art had branched into separate cultural systems. I had ended the Open fold by effectively switching branches from science to art but remained straddling both conceptual systems.

Figure 4.3

The Divided Self, Consort Gallery, Goodfellow, 1998

Systems have moved on significantly within society since the Open fold, and now society and culture is driven by information and its mediation. As already noted, in the 1990s the Internet was seen as a new tool of freedom for the individual, whereas now the underlying networks and systems are pulling people within its web, and a sense of self is being eroded. The critical art reception and response to the Post-Systems condition have included a reassessment of Systems Art, and from a British

perspective two important events were the Donna de Salvo curated exhibition, *Open Systems: Rethinking Art c. 1970*, at Tate Modern, (2005), and the *Systems Art Symposium* at the Whitechapel Gallery, (2007). These events in turn were preceded by several important papers, which lay the foundation for a re-evaluation of Systems Art. Edward Shanken was instrumental in this process with several papers, which reconsidered Systems Art and Jack Burnham's contribution to Conceptual Art. These included, *The House That Jack Built: Jack Burnham's Concept of 'Software' as a Metaphor for Art*, (1998) and *Art in the Information Age: Technology and Conceptual Art*, (2002). Since the Tate and Whitechapel exhibitions and associated symposia, there have also been several significant publications that have continued to rehabilitate systems thinking within art. These include*: The Art of Systems, Art, History and Systems Theory*, (Halsall, 2008), *White Heat Cold Logic: British Computer Art 1960-1980*, (Brown, Mason, Gere, & Lambert, 2009) *Art, Time and Technology*, (Gere, 2006) *Telematic Embrace: Visionary Theories of Art, Technology, and Consciousness,* (Ascott, 2008) and *Chronophobia, On Time in the Art of the 1960s*, (Lee, 2006).

A more recent text, *Systems we have loved*, (Meltzer, 2013) is the first book to capture the essence of Systems Art within the context of the Post Systems condition as it deals with the emotional, affective and post-humanity of living within a system. Although Meltzer discusses systems-based work from the first generation of Systems Art, she captures the sense of systems encroachment into our lives by stealth. For example, the emotional and affective dimension of artists who employ systems and structures in their work as they endlessly document and organise personal information. The artist Hanne Darboven, and her life's work of photographing, recording, annotating and archiving every correspondence captures that feeling of entrapment. Although created by hand these works exhibit the loss of self that systems absorption demands, and these works have an air of self-sacrifice. Darboven's mutation operates as sleeping agent for future complexity, but she defined it in modest terms.

> 'My systems are numerical concepts, which work in terms of progressions and... I like the least pretentious and most humble means, for my ideas depend on themselves and not upon material; it is the very nature of ideas to be non-materialistic. Many variations exist in my work.' (Darboven, 1968)

Such systemic compulsion remains affecting and visceral when seen laid out in an installation of longhand correspondence. It is, though, only the hand-written equivalent of what most people now willingly participate in as nodes within the systems-mediated social networks, and web-based Capital. This third and final consuming fold marks the shift in human evolution in which the contingency of the individual is now mediated externally from the body. In the past, we as individuals and small communities, could hunt or grow food, stay warm, socialise and reproduce. The limits placed upon us were to some degree tangible and similar to social structures in other species. The complexity of systems now means that it is extremely challenging to operate outside of the complex super-systems that control the world on both a material and social level.

During the positive mentality of the 1990s, no one anticipated our present Post-Systems condition. Instead, the expectation, seldom expressed, was that the informational operations of society would remain subjugated and operated somewhere else, with digital cyberspace visited and contained in data warehouses and the fiction of William Gibson's 'Neuromancer', (1984). Gibson, in the article *Google's Earth* for the New York Times, (August 31, 2010) discussed how cyberspace had unfolded in unexpected ways.

> Cyberspace, not so long ago, was a specific elsewhere, one we visited periodically, peering into it from the familiar physical world. Now cyberspace has everted. Turned itself inside out. Colonized the physical. Making Google a central and evolving structural unit not only of the architecture of cyberspace, but of the world. This is the sort of thing that empires and nation-states did, before. But empires and nation-states weren't organs of global human perception. They had their many eyes, certainly, but they didn't constitute a single multiplex eye for the entire human species. (Gibson, 2010)

Thus, one of the emergent qualities of this research is the feeling of saudade; for the open society that technology promised in the 1990s, but never arrived. Hito Stereyl, an artist of the Open Systems era lamented,

> 'The 1990s were about decoding and understanding these relations but now it's more about how to be immersed without drowning, or to be embedded without falling asleep and happily surrendering control of your feelings to a pervasive military-entertainment complex'. (Stereyl cited in Heiser, 2010)

Thus, we are now living in a world that is mediated and controlled by systems. We are therefore not wholly in control of the mechanisms that determine how we live or

how we consume information, and this had fundamental consequences for Contemporary Art and how we respond to our slow loss of self. Morton's trilogy of books on 'dark' ecological thinking are interesting as they in affect return us to Naess understanding of deep ecology, of the Primary fold, which de-centres the human but retains them within the ecological mix. He notes an increase in information reduces our sense of our own experience or life. Morton recalls the experience of observing time-lapse imagery of deforestation in the Amazon basin, and how this makes these processes simultaneously real and unreal. He states that '"lifeworld" was an optical illusion that depended on our not seeing the extra dimension that NASA, Google Earth, and global warming mapping open up' (Morton, 2012, p. 56). I had this exact experience of dislocation in my environmental work, which forced me to think of ecosystems and their representation in more critical terms. Looking at complex images of the Earth I had the sense that the world as a system was infinitely complex and beyond our comprehension.

The previous chapters have suggested that an artwork can be understood as an ecosystem, and thus, many of the broader discussion of ecology and the impending ecological crises can be applied to the complex artwork in analogical terms. It is also established that the ecosystem is a product of the mind, and the artwork can be extended by information or explained in informational terms. Thus, we can still talk about the artwork, and broader society in ecological terms, even when the world is increasingly dominated by information. This is not to say we are losing our grip on the real; rather we never had a firm grip in the first place. In the past the reality we could not grip was earthbound; whereas the reality we cannot grip now is increasingly a simulation, constructed from information. Thus, our mental constructions of reality are for each person a vertiginous mix of withdrawn material reality and its simulation, either externally imposed or actively created in one's mind. This gives context to the current mix of virtue signalling and mourning for a world damaged by humans and marks such contrition as chimerical. As Morton states, 'Nature elegy is a paradox, as it's about losing something we never really had: losing a fantasy, not a reality'. (2012, p. 106)

But we are definitely losing something, we can feel it, but we can't quite put our finger on it. 'Alexa, what are we losing?'

Mark Fisher proposes in *Ghosts of my life*, (2014) that one of the things we are losing in the 21st Century is the future. That is, prior to the Millennium there was an expectation of progression, and each generation would become fixed and be shocked by new culture. Whereas now according to Fisher, 'rather than the old recoiling from the 'new' in fear and incomprehension, those whose expectations were formed in an earlier era are more likely to be startled by the sheer persistence of recognisable forms' (Fisher, 2014, p.7). He gives the example of popular music, stating,

> 'It was through the mutations of popular music that many of those of us who grew up in the 1960s, 70s and 80s learned to measure the passage of cultural time. But faced with 21st-century music, it is the very sense of future shock which has disappeared.' (2014, p.7)

In the past, new things were unfolded for each generation, and a sense of evolution was felt; there was a cultural Fliessgleichgewicht or flowing balance. Whereas Delanda described this current situation as a 'flat ontology', in which things may differ in spatiotemporal scale but they share the same access. (Delanda, 2013, p.58) That is, if everything is equally available, through databases and the Internet, how can the past be differentiated from the present and how can the underlying production rules be determined to create the future? Guy Debord made a similar point forty years earlier, albeit in explicitly Marxist terms.

> 'The production process's constant innovations are not echoed in consumption, which presents nothing but an expanded repetition of the past. Because dead labor continues to dominate living labor, in spectacular time the past continues to dominate the present.' (2009, p. 109)

This quote captures the essence of cultural consumption on the Internet. Further, if culture can be understood as an ecosystem, then the Internet can be understood as its simulation, albeit many times larger than the thing it is simulating. Thus, in Baudrillard terms, this simulation will contain a lot of repetition and redundancy. Now we can we think of this simulated ecosystem in two ways. Firstly, if this ecosystem is a closed system, in the sense that it is so massive that it enfolds all cultural activity, then it will obey the second law of thermodynamics. Meaning energy will be gradually dissipated, entropy will increase, and the system moves towards a disordered equilibrium. During this process we may personally feel we are creating pockets of structure within the simulation,

through our online profiles, data archiving and storage activities, but this is a self-induced hallucination.

The alternative perspective is that culture is in a latent energy phase due to the scale of the simulation. Latent energy is the energy the system requires to undergo a ‘phase transition’. For example, to boil a pan of water, or to warm a planet heat needs to be applied. During the latent energy phase, there is no discernable temperature difference as the water molecules in both examples absorb the energy and start to vibrate. This is ‘hidden heat', and the larger the pan, (or planet), the longer the period of concealment. Thus, due to the scale of material now available to artists through the Internet, it could be argued that we are in a latent energy phase within culture, and the artist's energy is not wasted but is producing a ‘hidden heat'. Thus, there may be a generation of artists who must operate at this latent level, before entirely new forms of culture emerge on the foundations these artists have created. If this argument is compelling, then one would expect to see artists concerned with methodologies of access, archive, organisation and systems emerging to navigate the future. One could even argue the breakaway movements of Digital and Media Art are acting as reconnaissance for Contemporary Art as they seek to navigate the excess of information.

This reconnaissance is potentially dangerous as we have yet to evolve the psychological tools to cope with this flat, everything equally available culture. As Marks notes, ‘we are adapted to filter out noise as a function of survival’, but the simulation requires the unfiltered schizophrenic channelling of data to detect patterns and relationships. (Vernallis, Herzog, & Richardson, 2015, p. 105) The danger is that those who participate in this way will be absorbed into the simulation. Langdon Winner described this process as ‘reverse adaption’, as our lifeworld is moulded to the requirements of the system and not the other way around. As Winner notes,

> ‘Reverse adaption refers to the transformation of existing goals to accommodate a new technical means. Goals are in effect rearranged in accordance with the demands of the technological order. In extreme cases, the broader social context ceases to be relevant as long as technological demands are satisfied and maintained.’ (Veregin cited in Pickles, 1995, p. 97)

Thus, as individuals, we have shifted from carefully owning parts of culture, which are significant for us, such as a vinyl record to having access to all music, but without the mental resources to accommodate such complexity. Thus, artists must critically engage with this new reality. One way is through the injection of new signals and noise into these massive digital systems, as a distress beacon allowing others to navigate the informational excess; (hidden signals and noise disruptions that algorithms and artificial intelligence cannot decode). As Jean Robertson notes the stuff we are now dealing with is predominantly informational.

> Vast quantities of images and data are flowing from every source imaginable science, art, advertising, news, entertainment, governments, and, increasingly, ordinary citizens (using personal digital cameras, cell phone cameras, scanners, and webcams). Enormous digital databases are replacing physical archives (the latter ranging from libraries to family photo albums). The creative exploration and manipulation of digital databases as virtual structures is now central to the practice of an increasing number of new media artists. Their practice can resemble that of a virtual architect-reconfiguring an existing built structure (the database) in order to accentuate or reveal new properties and ideas. (2012, p. 17)

One response to this colonisation of the psyche with information is to expose the underlying systems that cause this submergence. I am particularly interested in the degree to which the informational experience is now separated from the first-hand experience. This is why I make an effort to collect my own data in my art practice, as however abstract, physically difficult or surreal the process I know the provenance of the information I use in my work. I can point to a square on a digital painting and know the colour value was physically collected at a given time and place. Whether it is from a summer walk through Görlitzer Park, or from an exhausting icy climb on Stac Pollaidh, there is a clear provenance to the indexed data values.

My proactive and critical engagement with systems may reflect the condition of my generation as I first encountered these technologies in the Open fold in the 1990s as a graduate student, and I, therefore, have a certain emotional distance. Thus, my experience of systems and technology has ranged from high expectations of utility and empowerment, through to saudade, and disillusionment. Whereas the artists born in the 1990s and beyond have always had access to these technologies and digital information is often the primary source of material for their work. Several commentators have described this digital condition. At the start of the new

millennium Lev Manovich described ‘Post-Media Aesthetics’ and ‘post-net’ culture, where the distribution of multi-media on the Internet was a given. Whereas the term ‘Post-Internet Art’ was first used by Marisa Olson and Gene McHugh on ‘Post Internet’, (2009-2012), an online blog that discussed the conditions of millennial art.

Thus, if the informational and digital landscape of the Post System condition is accepted as the ‘normal' conditions of contemporary culture for young artists, the distinctions between the layers of simulation become obscured. Any sense of what is world and what is simulation; and what is lifeworld, and what is simulation will be lost. As Fisher suggests, this is more than generational angst. (Fisher, 2014) There is a danger that such an uncritical engagement with these materials means that many artists are merely contributing to the circulation of information with a consequent reduction in meaning, and this massive expansion of information is dangerous as judgement is overstretched.

Some artists, of course, are operating within this mass of information, in much the same way as Hanne Darboven did on an analogue level. Jon Rafman, (born 1981), for example, has created work from the mess of information on Google Earth, and the Internet, such as *Still Life (Betamale)*, (2013), which captures the quagmire of these information ecosystems. Robertson suggests that such,

> ‘Artists who are concentrating on this area are pioneers in helping us to confront what it means to live in a world of accelerated information flow from multiple channels and to find ourselves entranced by manufactured virtual worlds’. (Robertson & McDaniel, 2012, p. 17)

Whilst other artists are finding ways to reassert the material object, and this is reflected in the critical turn towards Speculative Realism and Object-Oriented Ontology, which reassert the thingness of things, (despite information to the contrary). Katerinna Grosse, for example, combines the aesthetics of Post Internet art with the materiality of Land Art.

I am sitting somewhere in the middle as I am drawn to the systems and processes of things, but I am ultimately drawn to the thing itself. The artwork *Remotely Sensed*, (2014), for example, could not be explained solely through the ecosystem-information flow model. This work emerged in the studio, rather than through the application of system rules; likewise, its constitution defies simple ecosystem

description. Thus, in the next chapter, I consider how my system thinking evolved during this research to accommodate such disruptive works through a consideration of Actor-Theory Network Theory and Assemblage Theory.

Fold 3

Chapter 5

Extending Systems

Chapter 5: Extending Systems

Remotely Sensed, (2014-2018), cannot be neatly explained in the morphological terms of the ecosystem. Whilst it could be described as an ecosystem in the sense that it is an artwork consisting of disparate elements and processes the description is insufficient to account for their relations. This chapter considers how the model of the ecosystem can be extended to operate as a more flexible descriptive tool and I will use *Remotely Sensed*, and more recent paintings to illustrate this evolution. In particular, I will consider the *Constructed paintings*, as these are works created through the consolidation of disparate paintings to form new works, such as *Untitled Constructed Painting 001*, (2017), (figure 5.1). The individual paintings from which the new painting is constructed do not necessarily share the same generative roots, as they will not have been created using the same rules or techniques. As demonstrated in figures 5.1 and 5.2 there are several underlying rule systems in operation in this four-panel painting, and these are not shared across the work. Thus, the painting cannot be described in simple generative terms. As well as not originating from the same rule-based systems they do not originate from the same overarching project, or conceptual idea, such as a *System Walk*, (see Appendix 3). Thus, they cannot be reverse-engineered back into the original shared ideas, colours or processes. Instead, these hybrid systems have developed through the emergent dynamics between resilient objects to form new relationships. In a sense, these systems of things have emerged when the objects created either through rules or a systems-based project exhibit a degree of independence from their roots and they can, therefore, establish new relationships. To understand this, we need to extend the discussion of systems to allow such flexibility.

To do this we need to draw from Actor-Theory Network, developed by Bruno Latour, (1986) and Assemblage Theory, developed by Gilles Deleuze and Félix Guattari, and initially proposed in *A Thousand Plateaus* (1980). These can both be described as post-structural theories of society, as they seek to explain and understand society through the description of organisational structure. Systemic thinking may have originally grown from biology, but similar post-structural theories developed in the social sciences, in which social and cultural phenomena could be understood concerning their underlying organisation. Actor-Theory Network, (ANT), will be discussed first and then Assemblage Theory; although there will be some

concurrent discussion as they seek to address the same ‘problem space’ and some of their solutions are very similar.

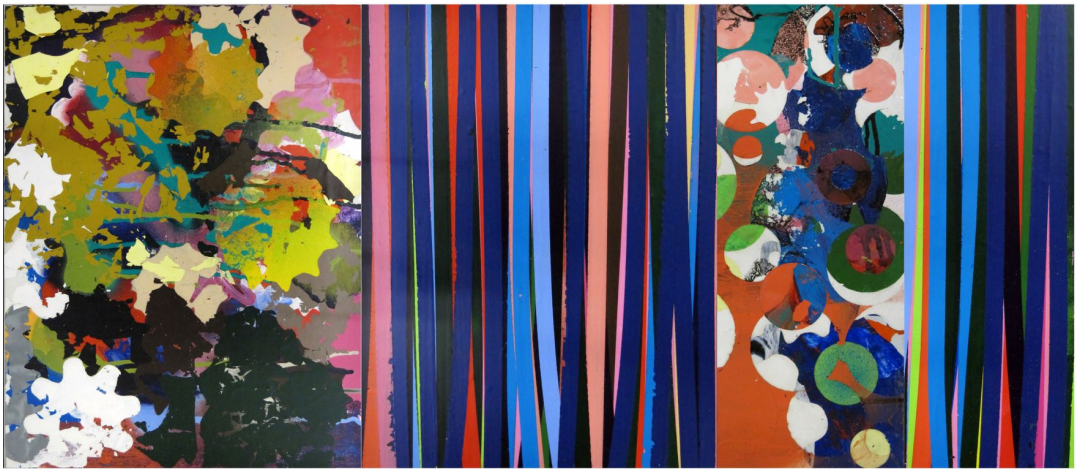


Figure 5.1

Untitled Constructed Painting 001, Goodfellow, 2017

Figure 5.2

Untitled Constructed Painting 001, Goodfellow, 2017 (detail)

Actor-Theory Network

ANT is an extremely useful tool, but something that is quite difficult to pin down. ANT is constructed from two fundamental concepts the ‘actor’ and the ‘network’. The theory is briefly discussed here, and the power of this as a critical tool in a contemporary art context will be addressed. The distinction will be made between the application of ANT to the analysis of art production, which is the primary concern of this thesis and the analysis of art reception, which is the secondary concern. It will be argued that ANT is more useful for understanding the dynamics and relations that emerge within art systems at the reception stage, as these are distributed and non-hierarchical. Whereas the dynamics at play in production are more structured, systemic and can be understood in morphological and temporal terms.

Bruno Latour, the critical thinker behind the theory, suggested somewhat ironically that, ‘there are four things that do not work with actor-network theory; the word actor, the word network, the word theory and the hyphen!' (Latour, 1995, p. 15). The underlying suggestion being that this is a tool that attempts the impossible job of pinning down complexity with a couple of discrete terms. As ANT is both a methodology applied in sociology and a social theory in which everything is understood concerning their dynamic relationships. This radically relational theory argues that nothing exists outside of networks. ANT is in part a response by Bruno Latour, Michel Callon and John Law to the positivist and structuralist sociology of Auguste Comte, and Emile Durkheim in which precise categories and dichotomies are employed, such as nature/society, macro/micro and object/human (Dudhwala, 2017, p. 2). This focus instead on ‘heterogeneous associations, tracing encounters and relations’ can also be traced back, in part, to the work of the Michel Serres according to Martin Müller (Müller, 2015, p. 30). A key aspect of ANT, (and Assemblage), is that it starts at the position of what is observed, rather than trying to fit what is observed with a preconceived notion of how something functions. This can be referred back to the paintings as if I consider them solely in rule-based or (original) ecosystem terms I do not see the paintings independently. That is, they would remain sitting within the categories that defined their production, rather than reception.

ANT is seen as an antidote to this prescription on two levels; the practical or material and the semiotic or conceptual. In practical terms, the utility of ANT was first

demonstrated with Michel Callon's analysis of Scallop production in St Brieuc, which demonstrated the underlying heterogeneity of the networks that encompassed this enterprise (Callon, 1986). Heterogeneity of the networks is a critical aspect of ANT, as it allows a network to encompass elements or actors that operate in seemingly different spheres. Thus, it is possible to describe the bay in St Brieuc, the scallop stocks, fisherman and market within a single heterogeneous network. Latour, (1996), elaborated that the term ‘network' in this context is not the fixed understanding of the term, as it is used in engineering to describe a telephone or computer network. In contrast, Latour describes ANT as a flexible tool to envisage relationships, which are not fixed in time and space, and, ‘neither will there be compulsory paths for the information to flow nor will there be strategically positioned nodes in which to send and receive information' (1996, p. 370).

The St Brieuc example could still be described in classic systems terms, but the model would quickly become large, inflexible and so vague as to have very limited utility as a descriptive tool. The scallop stocks, for example, can be described as concerning a sustainable ecosystem, but to force the same model to describe role of the fisherman and market would lead to a high degree of abstraction. This would also be true if applied to the Constructed paintings as they too derive from very different ideas and systems of production. Thus, they could be described as a collection of painted panels held together as a new system, but much of the original ideas and information are lost through this process. The power of ANT is that it can cut through such hierarchical and morphological descriptions, to describe how the new network operates as it is observed.

As noted with the St Brieuc example term ‘actor' does not refer only to human individuals, as actor, or ‘actant', may also refer to the non-human and non-individual entities within the network (Latour, 1996). Thus, there are networks of relations between nodes of people, things and institutions and these nodes are all actors. Latour suggests that ANT is an attempt to understand things as relational nodes within networks. Latour argues that a simple hierarchy of things and processes will not capture the complexity of modern society. As Latour states,

> ‘Modern societies cannot be described without recognising them as having a fibrous, thread-like, wiry, stringy, ropy, capillary character that is never captured by the notions of levels, layers, territories, spheres, categories, structure, systems. It aims at explaining the effects accounted for by those

> traditional words without having to buy the ontology, topology and politics that goes with them.' (1996, p. 371)

ANT is then similar to the concept of the 'Rhizome', proposed by Gilles Deleuze and Félix Guattari in *Capitalism and Schizophrenia*, (1972–1980). Like ANT the Rhizome proposes flexible and multiple relationships between things that are not hierarchical.

ANT networks connect the actors within the network, and these can be understood as the dynamic nodes within the network. They are not fixed as in the telephone network, but are multi-dimensional as they both have many connections within a network, and operate within many networks. Thus, the fisherman of St Brieuc is a multidimensional node operating in multiple networks. As he is a fisherman in the St Brieuc Scallop network, he could be a father in a family network, and possibly a bombard player in a Breton folk group. The topology of these ANT relationships are connected with lines, rather than enclosed by Venn-like boundaries. This, according to Latour brings greater conceptual freedom when considering relations in terms of scale, distance and boundary.

There is nothing, for example, within these ANT networks that prescribe scale. Thus, there is nothing inherent in the description of the St Brieuc Scallop network to suggest it is operating at a larger temporal scale, or that it encompasses a higher number of nodes than the wider Bréton community. As Latour notes,

> 'the notion of network allows us to dissolve the micro macro - distinction that has plagued social theory from its inception. The whole metaphor of scales going from the individual, to the nation state, through family, extended kin, groups, institutions etc. is replaced by a metaphor of connections.' (Latour, 1996, p. 373)

Whilst in *Reassembling the Social*, (2007) Latour warns against imposing hierarchies in a social context, stating that 'scale is the actors own achievement' (2007, p.185). He expands on this point noting that scale for the actor depends very much on the issue at stake. As Latour states

> 'if there is one thing you cannot do in the actor's stead it is to decide where they stand on a scale going from small to big, because at every turn of their many attempts at justifying their behavior they may suddenly mobilize the whole of humanity, France, capitalism, and reason while, a minute later, they

> might settle for a local compromise. Faced with such sudden shifts in scale, the only possible solution for the analyst is to take the shifting itself as her data and to see through which practical means 'absolute measure' is made to spread.' (2007, pp.184-185)

This is the case with an art object as the boundary of the work can change depending on the situation. Thus, a walk by Richard Long will momentarily occupy a vast amount of space, only to shrink down to a description or photograph. Long's walks often operate in terms of the line and ANT is a useful tool for considering how lines in particular can cover an immense distance, without occupying three-dimensional space. Latour makes this clear,

> 'A surface has an inside and an outside separated by a boundary. (Whereas) A network is all boundary without inside and outside. The only question one may ask is whether or not a connection is established between two elements.' (1996, p. 374)

ANT is not arguing that things cannot be observed and understood in terms of distance, scale, proximity and hierarchy, instead that there are additional forces at work, namely the 'actor.' Quantifiable parameters such as distance or hierarchy are readily observable in the world. One can understand the human body, for example, as being built from cells, and each cell is a simple system, whereas the body is a complex system. There is a clear hierarchy of complexity from a single cell, which is the basic structural and biological unit of a living organism through to a living human body. The life of the human body can then be understood as an 'emergent property' of this system of cells. The life the person leads cannot be understood merely as an emergent property, as the interactions they experience physically, socially, biologically and psychologically are infinitely complex and impossible to map in strictly topological terms. This too relates to the constructed paintings, as they may have been created from rules, but once in existence, their role as artworks and how they operate with other systems cannot be explained by these rules.

Thus, ANT is constructed from the two related concepts of the network, and the 'actor', with the network being the relationship between actors. Latour defines the actor or 'actant', as

> 'something that acts or to which activity is granted by others. It implies no special motivation of individual human actors, nor of humans in general. An actant can literally be anything provided it is granted to be the source of an action'. (1996, p. 375)

Thus, ANT is intriguing as it is not discussing interactions solely from the perspective of the human actor but is seeing the interactions of all things as equal participants in a flat ontology. This stance can be understood in terms of the 'Non-human' and 'Post-human' turns, in which the human experience is not the absolute centre of analysis; and the difference between these positions can be reduced to the way in which this loss of sovereignty is dealt with. Non-humanism sees this shift in essentially positive terms and as a necessary correction that is required to stabilise both the physical earth system and the cultural world. ANT fits with the thrust of the non-human turn, in particular, as the underlying motivation of non-humanism is to consider all things equally. Thus, the human experience is not privileged in an ANT network but is considered alongside the other actants, such as animals, ecosystems and technologies, for example. By contrast, post-humanism is something subtly different and technological that anticipates a physical earth and cultural world dominated by the digital signal and algorithmic processes. Morton criticises this position as proposing, even if ironically that humanity is turning towards the machine, rather than the more expansive opportunity ANT and non-humanism affords of turning towards everything. (Morton, 2012, p. 113) Latour clarifies the ANT position here as,

> 'The attribution of human, unhuman, nonhuman, inhuman, characteristics; the distribution of properties among these entities; the connections established between them; the circulation entailed by these attributions, distributions and connections; the transformation of those attributions, distributions and connections, of the many elements that circulates and of the few ways through which they are sent'. (1996, p. 375)

This idea can also be extended to consider how the newly constructed paintings work, as the objects now exhibit a level of autonomy from their means of production, and this shifts the status of the artist and viewer to one of equality as they are both now in a position of reception and must decode the new network of things.

This focus on the non-human within a system and thinking in more egalitarian terms for all participants is also present in Assemblage Theory, which creates a more balanced view of the world. As noted in chapter 2 ecological science has traditionally focused on the ecosystem, and to some degree excludes the human developmental imperative. Whereas development and economics can all too often reduce complex ecosystems to resources to be exploited without regard for their rights or

sustainability. ANT and Assemblage are therefore useful tools for the geographer and environmental scientist who is seeking to build a more complex picture of the world. Thus, in spirit if not method there is a lineage from Animism, through theories such as Gaia and onto the more culturally leveraged concepts of ANT and Assemblage. As Bennet notes, 'humans are always in composition with nonhumanity, never outside of a sticky web of connections or an ecology' (Bennett 2004, p.365).

In conclusion, the utility of ANT in the context of the thesis is in the mapping of complex systems, not in terms of how they were created, but how they are consumed. In particular from an artwork perspective how it becomes a cultural object and how it is understood in the broader network of things. ANT is good at showing the weaknesses of culturally defined systems, as it highlights how, in practice, power and relations cut across the ascribed structures.

Assemblage Theory

Assemblage Theory is a multifaceted tool, which can be applied to the analysis of interrelated phenomena, and as such operates within a similar territory to ANT, networks and systems thinking. Assemblage like ANT is somewhat intentionally challenging to pin down. Müller suggested that for Deleuze and Guattari assemblage was more of 'provisional analytical tool rather than a system of ideas geared towards an explanation that would make it a theory' (Müller, 2015, p. 28). Although a recent text, Manuel Delanda's *Assemblage Theory*, (Delanda, 2016), helps map it out in terms of a full theory, through its application in different social spheres, such as history, language and science. Deleuze defined an assemblage in *Dialogues* with Claire Parnet in the following way,

> 'It is a multiplicity which is made up of many heterogeneous terms and which establishes liaisons, relations between them across ages, sexes and reigns — different natures. Thus,, the assemblage's only unity is that of co-functioning: it is a symbiosis, a "sympathy". It is never filiations which are important but alliances, alloys; these are not successions, lines of descent, but contagions, epidemics, the wind.' (Cited in Delanda, 2016, p. 1)

Like ANT and other systems descriptions of the world, it is a relational model, each assemblage consisting of multiple, heterogeneous objects held together to form an assemblage. Like ANT, but unlike other systemic models derived from science, hierarchy is not the dominant organising principle of the assembled assemblage. This is not to say there are no morphological or organisational structures shaping the objects contained in the assemblage, instead that the assemblage is free to cut across these frameworks and offer something new descriptively

Raindrops, for example, formed millions of years ago, helped shape the *Grand Canyon*, through erosion, and these processes can be described in morphological terms, that deal with parameters such as hierarchy, scale and time. The relationships Assemblage seeks are not contingent on these morphological or hierarchically orderable processes. As Elizabeth Grosz noted, 'it is not that the world is without strata, totally flattened; rather, the hierarchies are not the result of substances and their nature and value but of modes of organization of disparate substances', (Grosz cited Müller, 2015, p. 29). Thus, an assemblage that encompassed the *Grand Canyon* may also encompass the local geo-politics, and the belief systems, as the canyon, is a holy site of the Pueblo peoples. Thus, an

assemblage is a useful ‘invention' that allows disparate but connected things to be held together. As Deleuze and Guattari note,

> ‘We will call an assemblage every constellation of singularities and traits deducted from the flow - selected, organized, stratified - in such a way as to converge . . . artificially or naturally. An assemblage is, in this sense, a veritable invention.’ (Delanda, 2016, p. 79)

This flexibility can be applied to an artwork, and we could refer to the *System Walks* discussed in the Withdrawn Fold, (Appendix 3). As noted in the appendix these projects start off with an underlying idea, and the production rules, invested energy and materials, and the resultant objects are understood as an artwork or ecosystem. The classic systems description of what we are looking at start, though, to unravel as the idea of the project evolves to include more ideas and materials. Thus, in the same way that a morphological description of the *Grand Canyon* can describe the effects of erosion, but not the geo-politics, so the standard ecosystem model can describe the basic interactions taking place within a work, but not other layers of emergent relations and information.

Other useful ideas that have derived from Assemblage Theory includes the idea of ‘exteriority' and the way that objects can retain an identity, or identity can emerge while still being held and described within a broader system. A problem with many system descriptions is the way the relations are foregrounded to the detriment of the actors or objects. Whereas Assemblages, according to Deleuze, consist of objects that are held together in a relationship, but still exhibit independence, or ‘exteriority'. There is also an emergent compound quality to the assemblage, as Delanda notes, 'the properties of the component parts can never explain the relations which constitute a whole', (Delanda, 2006, p. 10). This is a problem for art as it operates through a circulation of objects. Likewise, for the individual psyche, we are ourselves experiencing relations, as opposed to a mere conduit for relations.

The exteriority and independence or resilience of the objects is a crucial aspect of the Assemblage. Delanda gives the example of the biological relationship between parent and child within a family unit as being intrinsic or ‘interior’, as these define the relationship. As he notes,

> ‘if a relation constitutes the very identity of what it relates it cannot respect the heterogeneity of the components, but rather it tends to fuse them

> together into a homogeneous whole,' whereas a political alliance between two groups is extrinsic, or "exterior", as the alliance does not define the two participating parties'. (2016, p. 2)

This is a very useful idea in terms of the constructed paintings, as it reasserts the independence of objects borne of systems.

Following on from the concept of exteriority, Assemblages are by nature or invention heterogeneous. For example, a true assemblage in a social context would not only include the people of the community but other aspects that are not easily captured in a strictly hierarchical or systemic description of the community. Thus, a community as an assemblage would not only include the people but may also include the spaces, materials, rituals and processes. Bennet described them as 'socio-material', and thus, eschews the nature-culture divide (Bennett 2010). Again this allows the descriptive expansion of the system in a way that would be impossible in traditional hierarchical terms, and the model would become either unwieldy or vague.

Thus, a work, such as *Remote Sensing*, which is a system consisting of a sculptural form and films, can be described as an Assemblage, in a way that a traditional morphologically driven system would not accommodate. As the assemblage description can allow for a description of the contents of the films without contradicting the overarching structure. *Remote Sensing* contains two films; the first film shows the perpetual unfolding of curtains as if something is to be revealed. They are lit from the bottom, as if in a theatre or cinema, and therefore suggest that the ritual of story telling is about to be told or performed. However the curtain never opens, but phases in and out of abstraction, as it they are turning into pure light as if there is ultimately no story other than the play of photons, (figure 5.3). The second film shows a rock or object in space, which is constructed from smaller fragments constantly pulled apart and together again; or in Assemblage terms deterritorialised and reterritorialised. There is a strong sense that there is a central 'constant' object in the centre, but this perception is only kept stable through the constant flux of the material. Thus, there is a tension between the object and its relations, and what it is we are looking at. This is further compounded by the fragmentary nature in which

we observe the object, as we only observe image shards and reflections, which create infinite simulations, (figure 5.4).

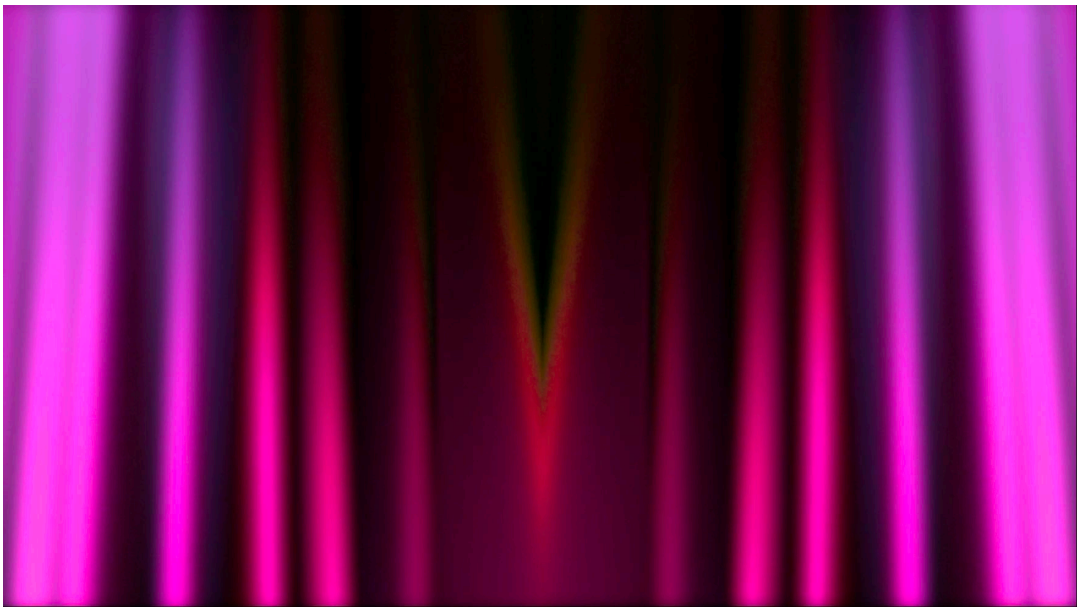


Figure 5.3

Remotely sensed, (detail), Goodfellow, 2014-2018

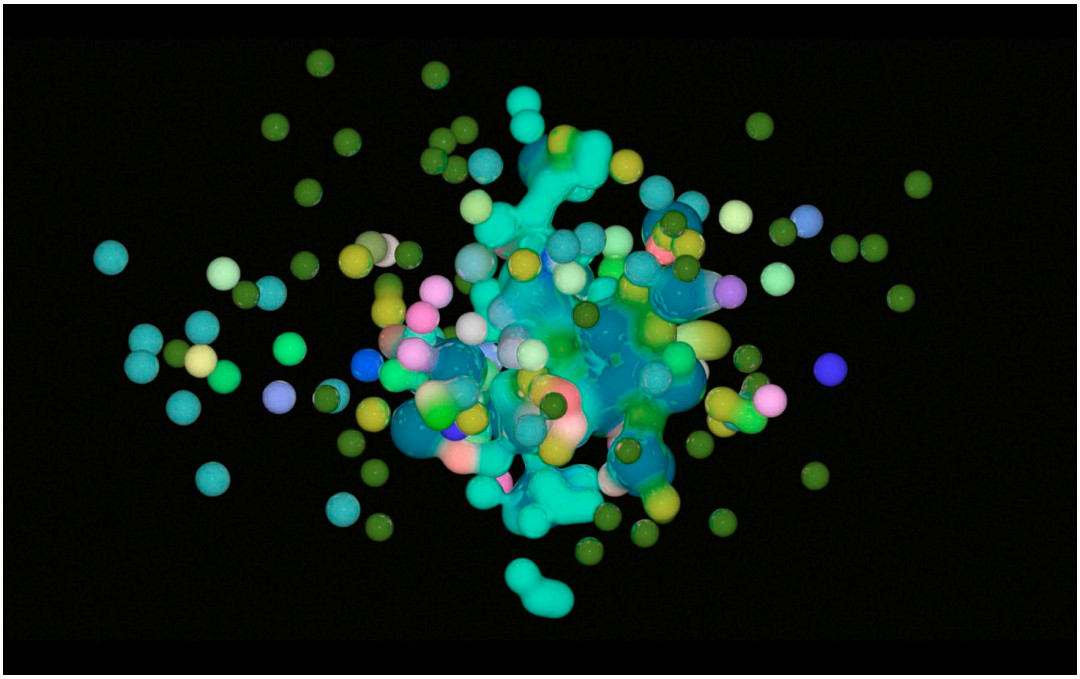


Figure 5.4

Remotely sensed, (detail), Goodfellow, 2014-2018

Although assemblages allow for very useful cross-fertilisations, influences and dialogues between objects operating at different scales it cannot wholly ignore that

hierarchies are present, particularly within nature. From a systems perspective, there is a clear hierarchy, between cells in animals and the full animal of the 'animal system', as the animal is a complex system built from cells. Ignoring the evolutionary causality dilemma of which came first the chicken or the cell, it can be said that structurally the cells precede the animal and Assemblage accounts for this through the layering, or nesting of assemblages. As Delanda notes, 'assemblages can become component parts of larger assemblages', (Delanda, 2016, p. 20), and he gives the example of community groups forming coalitions to become a larger groups or assemblages. Deleuze and Guattari developed the term 'molecular' to refer to the small or 'micro' assemblages and 'molar' to refer to the larger or 'macro' assemblages (Deleuze & Guattari, 2013). This description of how things operate at different scales is substantially compliant with a classical systems understanding of hierarchy, albeit with a more flexible language, which allows for fuzzy category boundaries. This is demonstrated by considering Delanda's description of the 'animal assemblage', and the role of genes (Delanda, 2016, p. 152). The concept of the clustered assemblage, such as the animal assemblage, is similar in approach to the concept of communities, which were discussed in Chapter 2 on ecosystems, as the concept allows for a description of hierarchy and scale, which are evidently present within nature, without the axis of hierarchy dominating relations.

An assemblage is, (as with other systems), a mental invention, and as such, it can concurrently exhibit both emergence and downward causation. Emergence is the demonstration of upward causation whereby the larger entities emerge through interactions among, the smaller and less complex objects, and the more massive object presents properties or behaviours not present at, the lower level. Whereas downward causation, which is closely related to the concept of emergence, proposes that once a complex system has emerged, it will start to influence the operation of its parts. Thus, the human body is made up of millions of cells, but the life the human lives will directly affect the cells of the body.

Moreover, as the assemblage exhibits emergence and new behaviours, and characteristics emerge from the interaction of the parts, it immediately starts acting as a source of limitations and opportunities for its parts, and this is downward causality. This also operates between nested sets of assemblages, as noted by Delanda,

> ‘At any given level causality operates in two directions at once: the bottom-up effect of the parts on the whole, and the top-down effect of the whole on its parts...Because of this bottom-up causality the emergent properties and capacities of a whole are immanent, that is, they are irreducible to its parts but do not transcend them, in the sense that if the parts stop interacting the whole itself ceases to exist, or becomes a mere aggregation of elements. But on the other hand, once a whole emerges it can exercise its own capacities not only to interact with other wholes, ..but to affect its own components, both constraining them and enabling them.’ (Delanda, 2016, p. 71)

Thus, it can be said that Assemblage is an interesting ‘a posteriori’ tool for describing both upward and downward causations observed in the assembled artworks that cannot be accurately described through reference back to the original morphological or rule-based descriptions that originally generated the work. Thus, observing an artwork as an object-system, (at the point of reception), may in-fact reveal relationships and ideas which were not apparent to me at the point of production, and therefore could not be distilled into a production rule, but reveal themselves in the making, and reflecting.

The additional assemblage concepts of deterritorialisation and reterritorialisation help explain how assemblages establish territories, how they are held together, but due to mutation and transformation will break up, before being re-established in another form. There is an inherently spatial dimension to these concepts, and this is interesting in the context of the ecological systems, and my practice of walking. Deterritorialisation and reterritorialisation are concepts developed to describe opposing forces that either binds things together in society or force them apart. Territorialisation is the force, which can hold things together and create a community of things, whereas deterritorialisation is the force whereby things once held together are forced apart, (Delanda, 2016, p.22) These concepts have been applied within sociology and anthropology to the weakening cultural ties to ‘place', due to changes in technology and communication. For example, an individual's social grouping is not contingent on their location, due to changes in communication, travel and the globalised markets. Thus, new re-groupings, which take place in youth culture, now transcend the traditional geographic and cultural boundaries and can be described as reterritorialisation. That is, the old local cultural bonds were broken; to be replaced by new globalised bonds.

Both the deterritorialised and reterritorialised social networks share the same characteristics of a ‘small-world-type network’, which cut to the shortest path between two actors. The difference is the contingency within these social networks has shifted from topology to shared interest. In mainstream culture, this tendency for people to operate within relatively small networks is inaccurately aligned to the concept of ‘six degrees of separation', first proposed by Frigyes Karinthy in his short story *Chains*, (1929). The basic premise of ‘six degrees' is that each person in the world can be connected through a chain of ‘a friend of a friend' statements to connect any two people in a maximum of six steps. In contrast, the concept of the ‘small-world' developed by Stanley Milgram operates somewhat differently. In the study, *An Experimental Study of the Small World Problem*, (Trevers & Millgram &, 1964), demonstrated how individuals operate within relatively small groups structured by factors such as geography, familial ties and interests. This is why within a huge population of individuals there are smaller semi-discrete small worlds structured by shared interests. The ‘academic’ Contemporary Art world, for example, is a small semi-discrete field of research which operates within a complex dialectical mix of practice, ritual, literary studies and philosophy, but is often mistaken as part of the larger Contemporary Art ‘market’, which operates more as an ephemeral outpost of the stock market.

Thus, the deterritorialised and reterritorialised networks described by Deleuze and Guattari are essentially small worlds that are being blown apart through social and technological change, for their constituents’ parts to be later reassembled and reterritorialised into new formations based on the new societal demands and the evolving interests of these actors. As noted the general trajectory of these small worlds is a move towards aspatiality due to the forces of the global market and the technologies that facilitate and demand it. In the past, most people operated within very small worlds as they were constrained by physical, social, political, religious and technological constraints. In *A Quiet Violence: View from a Bangladesh Village*, (Hartmann & Boyce, 1984), for example, the anthropologists Betsy Hartmann and James Boyce, describe the structure and operations of a Bangladesh village in the 1980s. They showed how kinship, politics, geography and technology lock the villages into poverty through narrowly prescribed networks. The book captures the beauty and tragedy of these constrained worlds and reading it in the early twenty-first century feels like a time-capsule from a much more distant past. In contrast, *Discordant Development*, (Gardner, 2012) written only twenty years later captures

the deterritorialising impact of globalisation and specifically the impact of multinational mining in Bangladesh. This text, if not implicitly drawing from the ideas of Deleuze and Guattari illustrate them, as it demonstrates how the old local networks are destroyed by globalisation and foreign capital only for new more distributed networks to emerge.

This can be directly applied to the how art objects, once created can come together in new configurations that cannot be explained in terms of their inception, but how they can mutate form new alliances, and fall apart again into discrete elements. I believe one of the most fundamental transformations my thinking has taken, as a painter during this research is the understanding that the paintings can break free from their morphological roots to become new forms through deterritorialisation and reterritorialisation. Thus, the works shift from being ecosystems to the more abstract Distributed Ecosystems.

Another interesting development from the aspatiality inferred by Deleuze and Guattari's concepts is to consider networks in a temporally distributed way. Thus, time could be considered in more fluid terms to allow networks to fall apart or be pulled into focus depending on the forces at play. In my practice, for example, I would claim I am directly influenced by amongst others Cy Twombly, Jack Burnham, Robert Smithson, and Bernard Frise. Each of whom occupies different dimensions in art historical and temporal terms, but I have reconstituted them into a rational network that operates across time. My practice reterritorialised them, even temporarily into a new assemblage or network.

The final useful idea from Assemblage and ANT is topology, and this has been referred to in Appendix 3 in relation to *System Walks*, as it allows an abstraction of space not traditionally available to geography. As topology, in their terms is not the strict spatial constructs that can be understood in x,y,z coordinates, but is imaginary, distributed and flexible. Thus, space can be distorted, crumpled or folded, such as the folded maps of Robert Smithson. As Latour observes, `I can be one metre away from someone in the next telephone booth, and be nevertheless more closely connected to my mother 6,000 miles away' (Latour 1996, p.371).

In conclusion, both Actor-Theory Network and Assemblage Theory are useful descriptive systems that help describe observed relationships in the world. Their power is that they are not constrained by the ecological and social hierarchies in the world, or how time and space functions to organise phenomena. Instead, they offer a higher level of descriptive abstraction that cuts through some of the structure present in the more formal systems of science and ecology. This allows them to help retain the nature of the resilient objects that emerge in art whilst describing their relationships. This desire to both understand the object-system dialectic and to find a way of balancing these two ways of understanding the artwork is very central to this research. Thus, one of the fundamental aspects of both ANT and Assemblage is that through the flexibility of concepts and language they manage to achieve this balancing act. This desire to find such a balance between objects and their relations is captured well in this extract from Jane Bennet.

> ‘But maybe there is no need to choose between objects or their relations. Since everyday, earthly experience routinely identifies some effects as coming from individual objects and some from larger systems (or, better put, from individuations within material configurations and from the complex assemblages in which they participate), why not aim for a theory that toggles between both kinds or magnitudes of "unit”?’ (Grusin, 2015, p. 228)

This profoundly resonates with the thrust of this thesis, as I seek in my practice to balance the compulsion to create material art objects with the compulsion to understand the systemic and procedural frameworks of this production, and the wider experienced world. The final chapter will draw from the disparate systems areas discussed in the thesis and the concept of the ‘Distributed Ecosystem’ is proposed to describe an artwork which is distributed across ideas, objects and processes, but remains held together as a coherent conceptual work.

Chapter 6

The Distributed Ecosystem

Chapter 6: The Distributed Ecosystem

Through my practice for this doctoral project, I have come to acknowledge that the art objects, which emerge from Systems Art, are not merely products of morphological or generative rules but can be experienced and can exist independently of the system. In the same way that we are more than our genetic code, and our plasticity is mediated by environment and experience; so artworks are more complex than the production rules imply, or systems describe. This is in part because the rules and systems, as we understand them, are approximations of what is happening when we make a piece of work. Thus, although each artwork can be understood as an ecosystem, they are inevitably quite abstract systems, as their distribution across ideas and materials, (and our perception of them), will change over time.

Therefore the final revision to the model of the ecosystem is to invoke the flexible concepts of Assemblage Theory and Actor-Network Theory to acknowledge this complexity. In particular, the paradox at the heart of systems must be recognized. Namely that as the complexity of the system increases it moves from being a description of the subject to being a simulation of the subject. This simulation will then become uncoupled from the original subject, and we are left with simulacra, which exists independently of the original subject and our future relationships with the simulacra do not lead us closer to the original subject; instead the original subject remains unknowably complex and withdrawn. Systems help understand the connections between things, but the danger is that the bigger the picture, (system) we build, the more it obscures the subject.

The original concept of the ecosystem was developed to describe the communities of living and non-living things. These descriptions are constructions of the mind and cannot possibly describe in any detail all of the specific objects within a given ecosystem and how they interact. As there are many hierarchies of objects within a system, and their boundaries and constitution change over time and space. As discussed the boundaries of a tree, for example, are fuzzy and these change as they absorb chemicals and communicate their distress. Thus, an explicitly material description of an ecosystem is impossible, although specific sampling of data can say, ‘at this place at this time our methods recorded this information'. Instead, the

holistic ecosystem model suggests the broader flows of material and information and gives a greater sense of the ‘out there'. This is not to say that our material engagement with the world is not essential; it is, as we are material-mental beings and we build our understanding of the world through our senses. Thus, the ice core samples that demonstrate the exponential increase in atmospheric carbon dioxide are incriminating layers of fixed information within the infinity of space-time.

The ecosystem concept is now developed further as I propose a final more abstract thinking tool, the ‘Ecosystem Resolution’ to describe the artwork, as an ecosystem as one resolution of relational things within the wider ecosystem. This allows the model of the ecosystem to be applied to a singular art object, which is a system at the material or molecular level, right through to the ‘out there' withdrawn plane of everything.

As mentioned earlier in the thesis the term ‘hierarchy’ is at times avoided as it has political associations, which would divert the discussion, or close the discussion down prematurely. The issue of hierarchy was to some degree side-stepped in Chapter 2 by discussing objects in terms of ‘resolution’ and ‘community’ of similar things, and Deleuze side steps it also by discussing hierarchy in terms of nested assemblages (Delanda, 2016, p.20). Thus, Assemblage theory allows for assemblages to become component parts of larger assemblages. Delanda notes that this approach allows assemblages to become ‘micro’ (molecular) and ‘macro’ (molar) relative to other assemblages. Thus, a molecule in the body is molecular relative to the body, which is molar. Thus, assemblage’s descriptions of scale and hierarchy, although different are compatible with those found in ecology, biology and geography.

From a geographic perspective it is understood that hierarchies and scales for some aspects of experience are mental constructs and epistemological in nature, as John Paul Jones states, ‘we may be best served by approaching scale not as an ontological structure which 'exists', but as an epistemological one - a way of knowing or apprehending’ (Marston, Jones, & Woodward, 2005, p. 416). Whilst other things in the material or social world can be described more tangibly in terms of hierarchy or scale. The cell, for example is tangibly part of the body, and the body is more complex than the cell. Thus, in structural complexity terms, the body is more

complex than the cell, and therefore there is a theoretical hierarchy between the concept of the body, and the concept of the cell. In reality both the cell and the body are in flux and subject to material change as they are both constructed of matter in transition. Morton describes matter as 'material for', as in 'a state of information', (Morton, 2013b, p. 42), meaning that some material has to be reterritorialised to be a cell assemblage at the molecular level and a larger assemblage of material has reterritorialised at the molar level to be the body. Thus, things can be seen temporarily operating in terms of scale in spatiotemporal terms and these can be classified in terms of scale. However, if we zoom out a little thermodynamics and second-order cybernetics remind us that we are participants in the process of observation and classification. Thus, the key-mediating factor in terms of these observed things is our ability to perceive them. Thus, instead of thinking in terms of scale or hierarchy we should be thinking in terms of the 'resolution' of our observation. This was very clear from a satellite image perspective as they had a fixed resolution, as the surface of the earth was sensed at different resolutions. Thus, a single pixel on a digital image of the earth could equate to either a square metre or 40 square metres, and our understanding of what we saw was relative to the resolution.

Of course, hierarchies exist as social constructions and they demonstrate upward and downward relations. The geographer Kearns is quoted in *Human geography without scale*, (2005) stating

> 'Hierarchies are created and then events at one named level provide the conditions of existence for events at other named levels. Events at the level of parliament are named national, and they provide the conditions of possibility or conditions of constraint upon events that are oriented to narrower spatial remits, such as a neighborhood. Of course, the reverse is also true, so- called national events have conditions of existence that must be met in neighborhoods.' (Marston et al., 2005, p. 420)

However, ANT demonstrates that our actions cut through these hierarchies, and an individual actor can operate at different levels and destabilise a socially constructed system by operating on a regional, national or global scale. This was demonstrated with the Tiananmen Square protests of 1989, which were a remakable demonstration of cross-scale agency.

Since this period the world and our interactions have become increasingly globalized, fluid and flattened. This was noted in the previous chapter in which the social structures within a Bangladesh village were predominantly local in the 1980s, (Hartmann & Boyce, 1984), but have shifted to being mediated transnationally in the 21st Century due to global trade, (Gardner, 2012). Further shifts, which demonstrate

the fluidity of social and spatial structures is demonstrated by the current crisis facing the Rohingya people in Myanmar. However, an understanding of the crisis must include a temporal and spatial dimension as this has unfolded over many years and across a region in which states and their boundaries have changed, often against the will of the population. The Rohingya are a Muslim minority who have lived in the region for centuries, but are now suffering persecution. The country Myanmar is predominantly Buddhist and was formally known as Burma during the period of British and military control. There is now, though, a mass exodus of the Rohingya people across to Bangladesh, their plight a quiet violence as it does not fit with the pervading western narrative of Myanmar (Ibrahim, 2018). Thus, the Rohingya arrive in Bangladesh, a country itself a reterritorialisation of Pakistan, (which in turn was a reterritorialisation of Bengal), and these spatio-political shifts make the complexities of scale and hierarchy within social structures unknowably complex. These are social shifts and fractures, but as noted in Chapter 2 the social and the ecological are intertwined, and if you look back far enough we see that Bangladesh as a concept and territory has been made possible by the territorialisation of the Ganges Delta. However this is only a temporary territory, as global warming will deterritorialise it back into the Bay of Bengal, which will force a far greater exodus. Thus, such a complex tragedy requires a multidimensional understanding, but if one zooms out too much we can't understand the past or present nor anticipate the future. Likewise if we completely unfold and flatten everything out as being equally available there is no underlying structure to make sense of things.

Thus, it is the case that society has become more complex, due to globalisation and more complex social, economic and political networks prevail, but this complexity is also perceptual as we have increasing access to information. Thus, the 'struggle' the average westerner experiences within the Post-Systems condition is an inability to differentiate between things, between the 'real', the simulation and simulacra. This is being played out in art and wider culture as we struggle to make sense of the flat world. The geographer Richard Smith describes this situation well in the following.

> 'In contrast to (an) interest in scales, boundaries and territories, my ontology of globalization fluidifies such solidified thinking revolving around such motifs as fluidity and flow, movement and mobility, folds and networks. A

> consequence of that ontology - where all that is solid melts into air - is a rejection of scales and boundaries altogether as globalization and world cities are too intermingled through scattered lines of humans and non-humans to be delimited in any meaningful sense.' (Marston et al., 2005, p. 423)

Thus, my approach to the art object and understanding its operation at different scales is to return to the term resolution, as it makes clear that the hierarchically-infused focus is a subjective lens through which excess is filtered and perceptually organised.

Thus, perceived reality is described in terms of resolution from the infinite plane, down to the modest singular object. In doing this, I acknowledge Kant's notion of the unknowable object, the 'thing-in-itself', which refers to the things which are independent of our senses. Kant argued that such 'out there' things must exist as fuel for thought, even if we cannot fully know them, and their existence must be accepted as an act of faith. To subsequent thinkers, this seemed contradictory. As Malik, Cox, & Jaskey note,

> 'On the one hand, Kant claimed that the thing-in-itself is unknowable, beyond the limit of human knowledge; yet, on the other hand, he nonetheless seemed to know enough about it to posit its existence and Thus, to transcend the limit he had declared impassable'. (2015, p. 17)

Whereas Hegel argued that there was not a clear division between the independent 'thing-in-itself', and the way we see it. Thus, two divergent branches of seeing grew from Kant and Hegel. Kant saw the real as real, but inaccessible and external to our minds, while Hegel saw the reality as that which is experienced in the mind.

Hegel's position can be seen in the dominant views within the humanities and Art since the axial period of the first wave onward. Where the interpretative discourses found in phenomenology, hermeneutics, post-structuralism, and deconstruction have foregrounded relations, discourse and social construction. Thus, theorists, I have drawn upon through this thesis, to invoke the relational nature of things, such as Derrida, Barthes and Baudrillard demonstrate this position. Derrida, for example, claimed that 'there is nothing outside of the text' (Malik, Cox, & Jaskey, 2015, p. 18). Whilst Jacques Lacan, made his position clear stating that, 'there is no such thing as a pre-discursive reality', and also 'it is the world of words that creates the world of things' (Malik, Cox, & Jaskey, 2015, p. 18).

During the same period, there have been various materialist alternatives, such as Scientific Realism, which argues that things can be described by science and such things are independent of interpretation. As noted I was initially drawn to science and ecology, and I, therefore, have had direct experience of such materialist thinking, and in particular Karl Popper's concept of falsification, which states that nothing, can be proved, only disproved. Popper was concerned that scientific statements could be testable or proved incorrect, and he defined this refutability as 'falsification'. As Popper notes,

> 'It is far from obvious, from a logical point of view, that we are justified in inferring universal statements from singular ones, no matter how numerous; for any conclusion drawn in this way may always turn out to be false: no matter how many instances of white swans we may have observed, this does not justify the conclusion that all swans are white.' (2002, p. 4)

Without this ability to be disproved something could not be held as scientific knowledge of the world, and I was demonstrating this lack of refutation on a daily basis in my work, as every time I interacted with the data a new pattern in the satellite images would emerge, or a new relationship between datasets inferred a new reality. Thus, Popper, whom I admired greatly, even hitching to Cambridge as an undergraduate to hear him speak, demonstrated the unrefutability of my work and I turned to art, which allowed such a multicursal approach to reality.

The system of data and maps was labyrinthine in its complexity, but also a labyrinth without a singular solution. Penelope Reed Doob, in the *The Idea of the Labyrinth*, (1992), and cited in Weed, (2004) noted that there were two types of labyrinth known to the middle ages: the unicursal and the multicursal, and she suggested that the labyrinth found in literature of the period was multicursal, as a 'forest of decisions that confounds the subject' (Weed, 2004, p.185). Whereas the labyrinth in medieval Art was unicursal, as it led the viewer through to a singular conclusion. Likewise, the information systems I dealt with shifted our view from a singular material conclusion to one of infinite complexity, as every new engagement with material created a new path through the data. Thus, in design terms the system, although complex, is a coherent simulation of the 'out there' ecology, but the experience of working within the labyrinth of information is one of disorientation. As Doob notes,

> ‘Viewing the labyrinth from above, the schematic view is to see a complicated and beautiful work of art, while the experience of the subject placed in the labyrinth is one of confusion and chaos'. (Weed, 2004, p.185)

It could be argued that Scientific Realism assumes a multicursal approach in which all individual branches of knowledge are unicursal, reductively meeting in the centre of the labyrinth, whereas art engagements with the world suggest an ever expanding and branching of reality.

There has, though, been an interesting development in the past decade that has seen a return to forms of materialism and realism, which assert that reality exists independently of our comprehension of it. As noted from a scientific perspective this is not such a radical position, as most scientists would accept that there is an ‘out there', even if we can only make approximate models of that ‘out there' reality, as we multicursally inch closer to the truth in a multidimensional pincer movement. However, the interest has arisen more from the continental philosophical tradition and the Arts, which have traditionally foregrounded the relational and textual readings of experience.

This ‘Realist turn’ developed, according to Malik, Cox, & Jaskey, (2015) on the foundations of Quentin Meillassoux’s work, and in particular *After Finitude*, (2006). Meillassoux argued that the preceding relational positions were all forms of ‘correlationism’ in which the conceptions of the world have been limited by our ability to experience it. Meillassoux argues the following

> ‘the central notion of philosophy since Kant seems to be that of correlation. By “correlation” we mean the idea according to which we only ever have access to the correlation between thinking and being, and never to either term considered apart from the other’. (Meillassoux & Badiou, 2009, p. 5)

Meillassoux and the wider return of realist thinking is underpinned by Francois Laruelle’s *Principles of Non-Philosophy*, (1999) in which he argued that ‘everything that is real exists together, and this includes thoughts and art text’ (Malik, Cox, & Jaskey, 2015, pp. 18-19) Thus, philosophical thoughts, artworks, rocks and forces that erode the rocks all operate within the boundaries of the real. Therefore the artist or philosopher cannot step outside this ultra complex ecosystem of thoughts and things so that it may be described in holistic terms.

This makes me recall the three types of thermodynamic system: open, closed, and isolated systems, discussed in chapter 2. These models could be applied to artworks, which operate as systems, although no functional artwork truly operates as an isolated system, totally withdrawn from the wider environment, as it is practically impossible. This is because the description of an artwork as an isolated system must include all the materials of the work, plus the artist and everything that has influenced the artist. Thus, the description of such a system would be so complex that it would be beyond our ability to describe or apprehend.

This however would be the situation with Laruelle's reality if it were to be described in system terms. Reality is, therefore, a completely isolated system, the only isolated system, and we do not have the access, capacity or perspective to fully apprehend it. Instead, shards of reality are reflected back to us using the instruments of science, philosophy and art. Laruelle described a philosophy, which attempted such a complete description of our relationship with reality as a 'transcendental hallucination', as we can never fully transcend the boundaries of the real. As Malik, Cox, & Jaskey note,

> 'attempts by philosophy and conceptual thought to get to the real, to capture and represent it, always necessarily fail because they are always already a part of the Real and Thus, cannot project themselves outside of the Real in order to capture its totality'. (2015, p. 20)

Deleuze, one of the most important relational thinkers, strongly endorsed Laruelle's 'non-philosophy', and did not see a contradiction between the linguistic turns and science, as he understood language as only one of many entities within reality, rather than the mediator of reality. (Malik, Cox, & Jaskey, 2015, p. 19)

The current speculative turn was ignited in the popular consciousness with the *Speculative Realism* conference at Goldsmiths, London, (2007), with key contributions from Graham Harman, Ray Brassier, Iain Hamilton Grant, Levi Bryant, Delanda, Steven Shaviro, Isabelle Stengers, and Meillassoux. They were initially united in a strong critique of correlationism and relational thinking, and a stealthy political desire to rebalance the climate-challenged world through a decentring of the human experience. Although not a speaker at this seminal event Timothy

Morton is central to the broader Anthropocene project of re-recasting the human as one-amongst-many actors in the world. His conception of the Hyperobject to describe the incomprehensibility of things, (or systems), which are distributed over vast distances of time and space has resonated with both my practice as an artist and my understanding of ecosystems. Likewise his concept of the mesh, (or system of things), which 'foregrounds' the space between things is a relational model of the world, even if it is written in the language of the object. Also, Jane Bennet is important in drawing from ANT and the vitalism of the Vitalists, (systems biologists), in painting a picture of a material world, which is one of all living things sharing the same Anthropocene fate.

During this thesis, I have read and enjoyed many of the Speculative Realist thinkers. They feel like an astringent tonic, hangover cure, or antidote to the complex, textual relational worlds we, as humans have created, (to avoid material action), and the complex immaterial worlds we now inhabit in cyberspace, (to avoid sensuality). Often written in, (relatively) clear language, about clear objects, combined with physical, affective experiences of mountains, rain and cold skin, are something I, and many artists have been drawn to; but these are only aspects of reality. Thus, from within these writers, I have tended to gravitate towards the thinkers that have not sought to extricate us from the mental world but have instead attempted to articulate a dialectical relationship between us, things and thoughts. Thus, Delanda, for example, offers an expansion of the Assemblage that is the most fully formed description of object-system relations. Whilst Bennett's vibrant matter is a coherent extension to Deleuze and Latour as she articulates the vitality of things and captures the political zeitgeist of species-thing recalibration.

Of all these writers I have enjoyed returning to Morton the most during this research, as he more fully captures the necessary adjustments we need to make as a species concerning our relations with the world. His dark materials have subtly infused this thesis, in the same way, that the Anthropocene has infused his philosophy. As he states,

> 'The ecological era we find ourselves in—whether we like it or not and whether we recognize it or not—makes necessary a searching revaluation of philosophy, politics, and art. The very idea of being "in" an era is in question. We are "in" the Anthropocene' (Morton, 2016, p. 159)

He describes the ‘dark ecological thought' as a lens through which culture should be viewed, and I suggest that the application of the ecosystem model to the functional understanding of the artwork contributes to this ecological thought. I would also argue that the ideas developed in this thesis contribute to an ecological art that has moved beyond the ‘happy eco-sincerity' of previous generations engagement with spaceship earth. As much as I draw comfort from the clarity of conviction in the early Systems Art of Smithson and Haacke, or the ecological writings of Fuller, Naess or Carson I understand we are, as a species, in transition, and the ecosystem we inhabit is changing. We are shifting from an era of terraforming and material dominion of the earth to one of system subservience, and our Lifeworld is now contingent on digital systems. These shifts from material engagement are something that may stabilise the planetary ecosystem, (Lovelock, 2007), but will potentially intern the human mind, and side-line the body. As we shift our focus from physically exploring the material resources of the planet towards virtual exploration, we become as rats choosing electrically induced synaptic highs over the natural dopamine delivered through food and sex. We are choosing the constant flow of secondary information over primary physical affective and mental experiences. For this reason, Speculative Realism and the orientation towards the material is a necessary corrective, akin to a booster rocket being deployed one last time in a vain attempt to adjust a spaceship’s trajectory as it heads directly for a black hole.

The problem, however, is that Speculative Realism does not usefully describe our full experience as humans. It may be able to describe us as humans, artists, carbon compounds, or future fossils, in object terms, but it says little about the forces that flow through us and hold us together, even temporarily as infinitely complex beings. The object-oriented ontology of Graham Harman, for example, is particularly extreme in his reduction of all material objects, material forces, and social interactions to objects. Reading Harman's ‘Immaterialism', (2016), for example, I found the description of the distributed actions and events that took place within the Dutch East India Company as ‘objects' unconvincing, whereas the substitution of the term ‘object' with ‘system' would have turned the text into a standard systems analysis. However, this is more than the semantic difference for Harman, as his objects hinge on their inexhaustibility, whereas as Morton's orientation towards objects feels more milieu expediency. Morton, for example, states,

> ‘An object withdraws from access. This means that its own parts can’t access it. Since an object’s parts can’t fully express the object, the object is not reducible to its parts.. An object can’t be reduced to its “whole” either. The whole is not greater than the sum of its parts.’ (Morton, 2013, p. 42)

This statement needs to be read in the context of his key concepts of the mesh and the hyperobject, which are two essentially systemic concepts. The mesh is a network of things in which the system foregrounds the space between things, and the hyperobject is a descriptive term for systems that are so large and so complex that we cannot apprehend or comprehend them. Thus, the above statement from Morton could be re-written from a systems perspective to state the following.

> A system withdraws from access. This means that its own parts can’t access it. Since a system’s parts can’t fully express the system, the system is not reducible to its parts. A system can’t be reduced to its “whole” either. The whole is not greater than the sum of its parts.

This does not however ‘call the whole thing off’, as semantic difference as in ‘You say potato and I say Solanum tuberosum, $(C_6H_{10}O_5)_n$’. As there is a definite contribution from the object-oriented thinkers, which extends the conception of the world as a system. It is their conception of withdrawal and the understanding that we can never fully apprehend, or exhaust the workings of things, due to their unknowable complexity.

To do this, it is worth considering a little further the object-oriented ontology, (OOO), of Graham Harman to establish this application. He, for example, distinguishes between OOO and ANT in the way that the actors of ANT, virtually disappear from the network descriptions as they are reduced to their actions. Harman notes that by reducing objects to their actions removes any hidden depth, as he notes,

> ‘you or I or a machine are not just what we happen to be doing at the moment, since we could easily be acting otherwise, or simply lying dormant, without thereby becoming utterly different things’. (Harman, 2016, pp. 2–3)

Harman concedes that Latour's ANT has positively shifted us away from overly textual readings of the world and to a world of interactions, but Latour's conception of the object is contingent, suggesting the objects are there to 'mediate relations', and be anchor points for actions, and is still human-focussed networks. As Harman correctly makes the point that most interactions in the universe take place without a human actor. (Harman, 2016, p. 6) He suggests further that an action-based description of the world is not very good at describing things that are not perceived to be acting:

> 'To treat objects solely as actors forgets that a thing acts because it exists rather than existing because it acts. Objects are sleeping giants holding their forces in reserve, and do not unleash all their energies at once'. (Harman, 2016, p.7)

Harman's arguments do not however negate the ANT model, only emphasize the utility of a flat ontology of irreducible objects. Levi Bryant described this as,

> 'a redrawing of distinctions and a decentering of the human. The point is not that we should think objects rather than humans. Such a formulation is based on the premise that humans constitute some special category that is other than objects, …but are rather objects among the various types of objects that exist or populate the world, each with their own specific powers and capacities.'(2011, p. 20)

Likewise, Harman's concern that an ANT, (action-based) description is incompatible with his dormant objects is wrong. As to describe a rock as sleeping is poetic but ineffectual, as compared to a physical description of it's molecular or chemical action. Sleeping is of course also an action!

At the centre of my practice has been this struggle to understand whether I was interested in things in themselves, what the things do, my experience of them, or a universal description of them. I have climbed into the crater of Azufral in Colombia and experienced the thingness of the mountain, and the effort required to get there. I have also accessed and manipulated data captured from satellites orbiting above Azufral, and thought through the volcanic processes and how the mountain mediates the social fabric of the surrounding communities. These are all valid experiences that relate to the mountain.

Likewise, the experience of another human is relational. I may have been drawn to an appearance of a person initially, but this is quickly replaced by an appreciation of their relational selves. So much so that when I have not seen someone for many years, I do not take their hand to study its form, but look deeply in their eyes to see if the same relational person is present. The body may have changed at a cellular level, and the processes of oxidation may have changed the appearance beyond recognition, but the essential vital spark of that person remains. This is also the case with an artwork, as a work is not only its appearance but also the affective, social, psychological and narrative functionality. This is demonstrated by Smithson's *Spiral Jetty* and Duchamp's *The Bride Stripped Bare*, as the impact of these distributed works far exceeds their material access.

Staying with Harman, we can consider three terms he developed which are useful in considering the dialectical relationship between objects and their relations: undermining, overmining and duomining. Harmon describes 'undermining' as an attempt to explain things in in terms of its smallest constituents, by way of a downward reduction (2016). This has been seen in science since Galileo, and the mechanistic world described by Isaac Newton and Rene Descartes. Descartes made the clear distinction between the exterior world of physical objects such as trees and bones that he described as the *res extensa* (or extended stuff), and the interior world of the mind, which he labelled as *res cogitans* (or thinking stuff). For Descartes everything in the universe, the *res extensa* was mechanical and underminable into component parts, except for the *res cogitans* the home of the soul and subjective experience. (Hornsby, 2001) For Harman, this special distinction Descartes makes between the body and mind, is problematic, as the products of the mind must, therefore, hold a special place in the schema of things somewhere between *res extensa and res cogitans.* As Harman notes,

> 'On the one hand, scientism insists that human consciousness is nothing special, and should be naturalized just like everything else. On the other hand, it also wants to preserve knowledge as a special kind of relation to the world quite different from the relations that raindrops and lizards have to the world. . . . For all their gloating over the fact that people are pieces of matter just like everything else, they also want' to claim that the very status of that utterance is somehow special. ..This is only possible because thought is given a unique ability to negate and transcend immediate experience, which inanimate matter is never allowed to do in such theories'. (Harman cited in Morton, 2013, p. 18)

The flaw at the heart of Newtonian physics and Descartes' Cartesian philosophy is the absolute faith in the scientific method to establish the truth about the world. This position was eroded within science during the early part of the 20th Century with advances in quantum physics and in particular the dual nature of the particle -wave, which we will return to. The specific problem for Harman is that these descriptions cannot account for the relative 'independence of objects from their constituent pieces or histories', as they demonstrate emergent qualities that cannot be attributed to the parts. He also noted that 'an object is not equal to the exact placement of its atoms, since within certain limits these atoms can be replaced, removed, or shifted without changing the object as a whole' (Harman, 2016, p. 9). Which also explains why the vital spark of a person remains, as in Shakespeare's, 'age cannot wither her, nor custom stale her infinite variety.'

Thus, if Harman sees the short-sightedness of science as the mechanistic thinking and undermining of the object as a collection of parts, he argues that the humanities and social sciences have the opposite issue of overmining. Here the object is literally over mined, as it is the basis for infinite textual analysis and discursion. Harman cites Latour as a key contemporary proponent and quotes Latour who states that 'there is no other way to define an actor through its actions, and there is no other way to define an action but by asking what other actors are modified, transformed, perturbed, or created' (2016, p. 10). Harman states that, 'The problem with overmining is that it allows objects no surplus of reality beyond whatever they modify, transform, perturb, or create' (2016, p. 10).

Harman claims that the reality in most analytical and critical strategies is to combine undermining and overmining as a 'two-faced reduction' known as 'duomining', which manages to miss the thing itself in the middle. (Harman, 2016, pp. 7–13) He gives the example of art and architecture, as these cannot be fully understood if they are reduced downward to their individual components, or projected upwards and outwards to their cultural role. This can be demonstrated with any artwork, but I will return to Jason Rhoades, and *The Creation Myth*, as this work and title feels

apposite. This work cannot be reduced to the mass and mess of materials that constitute it, without it dissembling into complete meaningless disorder. Likewise, the role of this work, and how it operates within institutional art is to some degree independent of the material-mental artwork that originated from Rhoades. This is because the work that Rhoades had in mind is just that, 'in mind', and his constant reconfiguring of materials performatively demonstrates the inaccessibility of making the work completely external to his mind. Part of the inaccessibility is because some aspects of a work are so deeply rooted in the subconscious that to externalise them is akin to trying to wake oneself during a dream. Thus, the external material 'artwork' is a version of the work or simulation, and thus works are remade, or made in series, in order to understand the underlying withdrawn artwork, or system.

Thus, to adequately describe an artwork, we must describe both object and its relations, and how the object function for both the artist and audience. The object then is, in informational terms, the channel through which the artist is using to encode things that are difficult to communicate in other ways, and the audience is seeking to decode through the channel. The object, will however, have its own characteristics and thus the audience will not necessarily be receiving the messages the artist intended.

Returning to Harman the danger with an institutional or critical description of a work overmines the artwork in relation to its role in wider culture, meaning that meanings are attributed to the work, which are not part of the object. The cultural role of an object, like a word, will evolve over time and operate in different ways for different audiences. Likewise overmining can take place from the perspective of the artist as they imagine the work is channelling ideas to others in a way that it isn't. Again, this may explain why an artist will constantly rework through the same conceptual or aesthetic idea, as they try to channel something withdrawn to the surface. This thesis operates in a similar way to this.

Thus, whatever is materially created is an object in the world and Harman states that each object has a withdrawn nature, and this is inaccessible, or withdrawn. However, I would argue that the withdrawn aspects of an object are its forces, qualities and relations, and consequently they should be described in systems terms. Thus, if the nature of an art object cannot be described, it is because its

system of influences and relations is unknowably complex, partly embedded within the artist and partly embedded within the audience that experiences the work.

Thus, Harman's ideas, like those of Morton and Delanda are not, (in this regard), in conflict with a systems view of the artwork, and comparisons can be made between Harman's concepts and the operation of systems. For example, ‘undermining' is a focus on the parts of the system, and complexity emerges through the interplay of these discrete parts. A systems-based description of an artwork, which undermines the work to focus on the rules of production, says little about the artwork, other than to describe the construction process. Likewise ‘overmining', or downward causality is demonstrated by complex systems as they describe systems that are held in balance through the exchange of material and information. These descriptions may overmine the system, as they may not accurately describe the functional roots of the system or artwork. An ANT description of an artwork may operate in this way, as it may offer insights into how the parts interact, but not how they came in to being.

The ecosystem model, discussed throughout this text, can be considered in duomining terms, as although some of the morphological processes can be explained in upwardly causal terms the overarching system is a description which has the potential to overmine, as it is a downward description of what is seen. Two forms of this have been discussed in this thesis, and they can both be understood as ecosystems. Firstly there are systems that are generated from rules and processes that are to some degree known, and although they expand beyond the confines of these rules they exhibit both upward and downward causality, as they can be described as balanced systems, and some of their generative functions are known. *Systems Walks* are an example of such as an ecosystem, as they are part generative, and part ‘a posteriori’ description.

The second form of complex art system exhibits little or no upward causality as the rules through which the work was created are obscured from both the artist and audience. However, they do exhibit the characteristics of a system, as they are complex, but materially and informationally balanced as they exchange information, and *Remote Sensing*, (2015-2018), is an example of such a system. Descriptions of such complex systems have required the additional flexibility that ANT and Assemblage bring to system thinking as they enfold and unfold time and space in

more abstract ways than demonstrated in the ecological model of the ecosystem. As noted Meillassoux describes this way of seeing the world as correlationist, and claims that such descriptions are ‘merely retroactive fictions generated by present consciousness about a past that is itself a construct of the correlation.' (Malik, Cox, & Jaskey, 2015, p. 21)

Is it, however, a problem that we create stories about how things are created, or how they function in the world, as these are necessarily contingent on the beholder, and will, therefore, change over time and space? As I would argue one of the current crises of culture is the unstoried flatness of everything, everywhere, now, which gives no clue as to how to navigate the lifeworld or material world.

Flexible stories are systems for passing on messages. The Genesis creation story found in the Christian and Judaic traditions and Rhoades' *Creation Myth*, are examples of complex and informationally rich stories, which allow for an infinity of reconfiguration and interpretation. Even Meillassoux, acknowledges in *After Finitude*, (2006), that the poststructuralist philosophy, (of Deleuze in particular), confirms that as ‘any correlation is contingent and that this contingency is not internal to the correlation but external to it, absolute, a feature of the world itself.' (Meillassoux & Badiou, 2009, p. 52) This means that such relational stories are part of our reality and can, therefore, be described in systems terms on some useful level. This leads to the final relational thought on the hierarchy of ecosystems.

This chapter has to some degree acknowledged the complexity of an artwork as a material object. Likewise, it has acknowledged the current cultural climate, which is seeking to re-affirm the material source of our affective experience of the world, as we are faced with the threats of the climate crisis and digital sublimation. Moreover, whilst having acknowledged these contemporary contexts I return to the clarity and flexibility of the distributed ecosystem model to describe the artwork and our experience of the world. The model is now developed further as I propose an understanding of systems in terms of resolution from the infinite plane, down to the modest singular object. I will conclude with the model of the ecosystem applied to a simple art object, which is not a dormant, sleeping thing, but a system of molecular activity and infinite potential relations, simultaneously particle and wave.

At the extreme of infinity there is the ‘Infinite Ecosystem’, the out there, which is composed of the totality of the mental and material world, constructed from waves and particles, that is, the interaction-of-things. This is infinitely complex and beyond the comprehension of the mind as it contains the material everything, plus the infinite branches of what could be imagined. This encompasses every thought of every mind, but it is also fundamentally withdrawn from any given mind, due to its infinite complexity and inaccessibility. Thus, it encompasses every thought the artist has, whether described through drawing, poetry, a brain scan, or chemical process. Likewise, it encompasses the ‘thoughts' and sensations of all other creatures throughout time. Thus, the feline equivalent of saudade felt, by the cat, at the Hotel du Théatre, when Breton’s Nadja fails to return, is part of the Infinite Ecosystem. Even if the cat did not exist, I have had that thought-picture of the cat, (and so have you), and these thoughts are now part of the infinite ecosystem. We may now even feel saudade for the cat who never existed. Thus, every time we have a thought or sensation the world is rhizomatically extended. Thus, as science anticipates a multicursal reduction to a unicursal description of the world, so our thoughts demonstrate a multicursal expansion of an infinitely multicursal reality. See the Withdrawn Fold, (appendix 3), to contextualise the imaginary cat.

At a less complex level, but still too complex to fully comprehend is the ‘Complete Ecosystem', a system which describes the interactions of the material and thoughts of an individual person or thing. This dynamic open system absorbs and exchanges information and is held together through the functioning, in the case of an animal, the body and mind. However, when the body and mind stop there is entropic collapse and the remaining material and energy is dissipated back into the wider Infinite Ecosystem. However, nothing is lost as everything remains within the totality of the infinite, including the dissipation. Thus, the individual is momentarily complete, a temporary discrete system, but even during this brief assemblage some individuals are drawn to seek the infinite through philosophy, science, religion and art. The advantage art, Buddhism and Hinduism have over most of these approaches is the recognition that we cannot understand the infinite as we are part of it. We are not satellites remotely sensing infinity, but participants on the ground; ground-truthing through direct experience.

As a Complete Ecosystem, the artist is compelled to make visible aspects of the Infinite Ecosystem, which only they have access to, (as they are products of their mind). Moreover, they do this through the production of work, which is distributed across space, time, materials and process. The artist will also be aware of the shared knowledge of the infinite, and they are merely reconfiguring this ‘common knowledge' for fresh scrutiny, and in doing so a new branch of meaning rhizomatically sprouts. Whereas some aspects of the infinite are unknown to the artist at a conscious level and these are revealed, either to the artist, or viewer of the work through the sifting of materials and processes. The totality of this work by the artist can be understood as a Compound Ecosystem, as it is the summation of ideas, material objects, influences and relations.

The individual projects of the artist can be understood as Distributed ecosystems, and these demonstrate either upward causality or downward causality. Ecosystems that demonstrate upward causality are generated from a set of rules or processes and these rules and the generated objects together can be understood as an ecosystem. Whereas the ecosystems that demonstrate downward causality are created by the artist putting together materials and processes which can only be explained in ‘a posteriori’ terms. Thus, Distributed ecosystems may contain morphological experience, such how a slow breath calms the amygdala, but could also contain more abstract shards of insight, which are fragmentary glimpses of the infinite.

At the simplest granular level material objects and their processes; both particle and wave constitute the singular object. The artist and audience can respond and gain access to aspects of the Infinite through engagement with these ‘independent objects’ without any knowledge of the intermediate ecosystems involved. Thus, someone can respond to a painting, sculpture or performance without prior knowledge and feel the gravitational tension between the earthly present and infinity, and every time someone engages with a material object another branch of infinity is articulated.

Ecosystem Levels	**Description**
Infinite Ecosystem	The complete material-mental world of all interacting things and processes
Complete Ecosystem	The complete material-mental activity of a single sentient life
Compound Ecosystem	The compound outputs of the artist
Distributed Ecosystem	A specific Artwork as an ecosystem
Independent objects	Specific objects that may be products of an art system, but equally be something experienced in the world, such as a rock. These can be understood as both particle and wave, object and its relations.

Figure 6.1

Ecosystem Resolutions

Conclusions

The return to the materiality of both the artwork and human condition is in part a reaction to the Post Systems condition in which everything appears mediated by incomprehensibly massive systems. We may, therefore, feel lost, and need the material objects to ground us. We are, though, in a sense already grounded in our bodies and the dialectic played out in this thesis between the material and relational nature of the artwork is the same thing that is happening at the corporal level. That is, our physical body grounds us in the earth in a way that cannot be fully dissipated by the hyper systems enfolding culture and our lifeworld. As Hayles notes, '(the) human being is first of all embodied being, and the complexities of this embodiment mean that human awareness unfolds in ways very different from those of intelligence embodied in cybernetic machines' (Hayles, 1999, pp. 282–283). Hayles makes the comparison here between cybernetic machines and the embodied being, but the description applies to the wider concept of the system and its relation to the body; as the term system encapsulates the broader operations of the machine that extends beyond the algorithm and along its roots and tendrils that seek to enfold culture.

However, there is an increasingly symbiotic relationship developing between the embodied self and the system, and this thesis has attempted to consider this from the perspective of the art object, and how the artwork can be understood as both a system and object. In the grand narratives of modernism, meanings were embedded in an artwork, and these works were to be navigated by the audience in a unicursal manner until the intended meanings were reached. In such works, the journey became an exercise in uni-linear unfolding. Conceptual art, though, circumnavigated the journey by cutting a direct path to the meaning through the employment of precise language and symbols. Derrida derailed this strategy as he demonstrated that meaning has become structurally decoupled from the author, and is instead structurally coupled within a wider system. Therefore a work of art cannot now be understood as having a singular reading, but instead, be seen as operating as a system that facilitates multiple meanings.

Thus, this thesis has sought to demonstrate the complex relationship I, as a practising artist have with systems. I am repelled by the pervasiveness of the massive external systems as they penetrate and demand attention from my interior

world, but I am also drawn to the way systems can be harnessed to externalise the mental simulation of reality I hold in my mind. Its power lies in its ability to scope out an idea, problem or image without locating a specific origin or question, in order to generate multiple readings and messages. That is, the system concept affords sufficient structure in which the artist can begin to investigate and experiment without a predetermined end goal. Hayles captures the power of employing systems and the indeterminate nature in the following statement.

> Meaning is not front-loaded into the system, and the origin does not act to ground signification. As we have seen..complexity evolves from highly recursive processes being applied to simple rules. Rather than proceeding along a trajectory toward a known end, such systems evolve toward an open future marked by contingency and unpredictability. Meaning is not guaranteed by a coherent origin; rather, it is made possible (but not inevitable) by the blind force of evolution finding workable solutions within given parameters. (Hayles, 1999, p. 285)

Such a systems model of art enquiry supports the idea of ever-increasing plentitude, discussed in this final chapter. In that, the system is a useful device for the artist to map out something that is so massive that they cannot articulate it in explicit terms, but can instead continually unfold their enquiry. Thus, the artwork is then a simulation of something removed from conscious thought, and even the boundaries of the simulation are to some degree withdrawn from the artist.

As noted the artwork as a system can be constructed from rules, and patterns and complexity emerge from the application of these rules. Such systems are exhibiting upward causality, and although the patterns are complex, their lineage is understood. Other systems can only be described in downwardly causal terms, and described once they are in operation in the world, and tools such as Assemblage Theory can describe their presence even if the system description is not corroborated at a morphological level. However, systems are more than the products of observable rules and patterns, as most of experienced reality cannot be reduced to such orderly pattern. This is true of ecosystems, global warming and complex artworks, but these can still be understood as systems or simulations of systems, albeit ones which are so complex that they exhibit noise and randomness.

This is demonstrated by the work of Cy Twombly as his work is exceptionally complex in system terms, and exhibits elements which could be described as noise and randomness; as the causal relationship between the ideas, processes and materials he invests into his work and the completed paintings demonstrate a very complex non-linear relationship. As it is difficult or impossible to fully model the inputs, interactions and outputs of a complex non-linear system it is impossible to fully distinguish between intentional signals, unintentional signals and noise in the system. Twombly's use of Rilke's poetry, for example, could be considered as an intentional input of information, but its incorporation unfolds in unexpected ways. Whereas the spontaneous calligraphic gestures used to transcribe a stanza onto the canvas could be described as unintentional signals, noise or randomness. The way he has written 'Victory' for example may suggest, joy when in actuality, it was something physical and affective he was experiencing in the moment.

Other things in a painting, such as the process of gravity in the *Rose* paintings, (2008) could be described as a morphological process. This could be either an intentional or unintentional signal depending on whether it was something Twombly intended as a process. They are not, though, strictly noise or randomness, but part of a system which is so complex, that its description is beyond description. Twombly's painting is truly systemic, and like nature, it is not random, in the entropic sense, but incredibly complex. As Hayles states.

> 'Randomness rather than pattern is invested with plenitude. If pattern is the realization of a certain set of possibilities, randomness is the much, much larger set of everything else, from phenomena that cannot be rendered coherent by a given system's organization to those the system cannot perceive at all. In Gregory Bateson's cybernetic epistemology, randomness is what exists outside the confines of the box in which a system is located; it is the larger and unknowable complexity for which the perceptual processes of an organism are a metaphor.' (Hayles, 1999, p. 286)

Thus, noise may not be noise at all but signals that we do not understand. As Sha Xin-Wei suggested, noise is 'patterned material', which operates at the 'limit of measurement, and therefore observation' ((Vernallis, Herzog, & Richardson, 2015,

p.104). Thus, artists may employ systems of production or operation in order to finely 'tune' into these complex signals. However, the artist is not necessarily 'understanding' these signals at a conscious level, rather they are, in informational terms 'channeling' these signals through the system. Thus, compositional abstraction within visual art, and sonic noise within music is an attempt to expand the system and engage with the 'unknowable complexity'. As Morton states,

> 'The psychotic intensity of Expressionist painting, poetry, and music Thus, expresses something … much more effectively than a cool mathematical diagram of phasing flows. The diagram is the caricature… (Whilst), a claustrophobic universe unveils itself to us, crammed with things: radiation, solar flares, interstellar dust… Expressionism abolishes the play between background and foreground. Objects thrust themselves towards us in a cramped or claustrophobic pictorial space. The sensation of world, on this view, is the false consciousness of gaps and backgrounds between and behind things.' (Morton, 2013, p. 76)

Thus, systems give the artist a framework in which to operate at the borderline of consciousness. Without the structure, the 'self' would be lost, enfolded within the unknowable complexity of the exterior world. In a sense, the systems we employ; the rituals in the studio, gallery, church or temple, structure the myth of independent agency. As Hayles suggests, 'autonomous will is merely the story consciousness tells itself to explain results that actually come about through chaotic dynamics and emergent structures' (Hayles, 1999, p. 288). Thus, our 'lifeworld' is not so much an optical illusion, but a dynamic system close to disequilibrium.

We are now living in the Post System condition, and as Hayles noted nearly twenty years earlier, 'every day we participate in systems whose total cognitive capacity exceeds our individual knowledge' (Hayles, 1999, p. 288). In the past humans thought they knew the extent of their environment, and it was something they controlled, but the enfolding virtual systems and the Hyperobject of global warming demonstrate both a lack of apprehension or mastery.

This thesis has considered the operation of systems at the level of the artwork, and in doing so, has allowed a broader discussion of systems within society and how they impact on the individual externally on a social level, and internally at a lifeworld level. A range of tools have been assembled during this research to equip the artist

to consider their practice and production methods in terms of systems, and these are briefly summarised here.

The concept of the ‘Ecosystem’ is the primary tool put forward in this research, as a way of conceptualising the artwork as a system that needs to be sustained through the balancing of material and information exchanges. Its power is the ability to describe on a very detailed level the small morphological or rule-based processes, whilst at the same time being able to describe the overarching operation of the system on a more flexible abstract level. The tool also positions the artist’s thinking within a more holistic framework in which the artist’s experience of the work is decentred.

The ‘Resolution of Structure’ is a model developed from ecosystem thinking in which art can be understood in terms of complexity; from simple morphological processes through to objects and onto more complex systems of objects and process. Understanding the artwork in this way allows the artist to construct very precise descriptions of how something functions at the morphological level, which is consistent with the broader speculative and retrospective overarching ecosystem descriptions at the most complex level.

The ‘Community Scale’, is a similar tool to the ‘‘Resolution of Structure’, but this has a narrower taxonomic role of identifying and classifying the component parts of art systems. This allows the artist to consider the objects they make in terms of series, functional groupings, related groups and ecosystems. This allows the artist to mentally map the relational roles between the objects and how their practice evolves materially across object groups.

The application of ‘Information Categories’ allows the artist to functionally understand the different information types that contribute to an artwork. Building on the work of Goonatilake, (1991) and Bates, (2006) a simplified set of information categories were proposed, which help the artist disaggregate between information types, which will, in turn, help them more fully differentiate and reflect upon the signals and messages they are channelling through an artwork. It also helps disaggregate between intentional signals, unintentional signals, and the primary role

of noise within contemporary art to disrupt the dominant systems within society. See appendix 2.

The application of the Information Categories was facilitated in the research by the concept of Fliessgleichgewicht, or flowing balance and the employment of a simplified version of Shannon and Weaver's *Model of Communication* to visualise the flow of information and material through the artwork from artist to audience. This model is useful as it helps to explicitly visualise the role of the channel, (artwork) in channelling the signal and noise to the audience. Likewise, it makes clear the role of feedback in the development of an individual artwork and more broadly the artist's practice.

The studio practice during the research demonstrated both the utility of these tools, but also the withdrawn nature of the artworks that emerge within practice. As some works seemed to appear as fully formed objects and this made me consider aspects of Speculative Realism and the reassertion of the thingness of things. These works and this wider reading did not, though, decentre the holistic and relational nature of my practice. Rather the withdrawn nature of the object can be understood as the relations that the objects have or could potentially have, and therefore the object can still be described in systems terms.

This understanding helped revise the model of the ecosystem with the addition of the concept of 'Distribution', as it accommodates a more flexible account of the ecological artwork. The concept of distribution gives an additional level of abstraction to the model and allowing relationships to be drawn between actors within an ecosystem in ways that defy a strictly hierarchical-morphological description. This concept draws from Actor-Theory Network and Assemblage Theory in order to describe artworks that emerge in ways that cannot be neatly reverse-engineered in systems terms.

The final thinking tool proposed in this chapter is the 'Resolution of Ecosystems', in which scales of ecosystems can be seen in operation. That is, layers of systems are created; part real, part simulation, as we seek to make sense of our mental and material experiences. The power of the distributed artwork is that this sense-making

process is laid out for others to experience, and in the process, the work unfolds further. This final tool demonstrates that the ecosystem model can describe different scales of system and its strength is its ability to describe an observed ecosystem from the ground up, through morphological processes, whilst simultaneously describing the overarching system at a more flexible abstract level.

The concept of distribution moves beyond the notion of the ‘expanded' artwork to consider the artwork as sitting across different objects and processes, which evolve over time. Taken together ‘distribution' and ‘ecosystem', describe an artwork, which is constitutionally dynamic, but structurally coherent. In biological systems terms, the Distributed Ecosystem exhibits autopoiesis, or self-organisation, as even though the work may evolve there is an underlying structural coherence, even if its unknowable complexity prevents description. The essential life of the artwork is then an emergent quality of its complexity. Likewise, the ‘self', or ‘lifeworld' of the individual is an emergent quality of a complex system of physical and mental interactions, and an artist's practice is the unfolding of the self as an externalized simulation.

Thus, the two conceptual propositions that first interested me from the Primary fold of systems, that of the ‘ecosystem’ and its related notion of an ‘information system’, have unfurled in this study both as extended ideas and as expanded practices in relation to my participation in the fields of environmental science, information visualisation, and art. In turning these extensions and expansions into a doctoral research project, I have sought to describe and explain my own expanded expectations of the term ‘system'. These concluding comments, in debating the accelerating complexity of systems thinking, are unavoidably tied to theoretical models that capture not only the widening and broadening of this type of thinking but also demonstrate the prolongation and lengthening of description required when contemplating the withdrawals and deferrals of creative processes. Therefore, it is important to note that this research has been undertaken by a ‘self' who is no longer an environmental scientist, or designer of visualisations; rather, this thesis has been written by an artist totally immersed in the thought-processes stimulated by systems-based art practice. As a result, my readings of thinkers such as Latour, Deleuze and Guattari, and Timothy Morton (to name but a few) are not just a matter of more text, but also an appeal for more artworks. Therefore, my own studio and

exhibition practices are, on reflection, just one product of research activities that have absorbed the idea of an extensively distributed ecosystem. Having reached this final folding over of ideas in my PhD investigation, my ambition now must be to use the theoretical and practical discoveries of my project to encourage further practice-based research on the unknowability of distributed, environmental-scale, systems.

References

Ascott, R. (2008). *Telematic Embrace: Visionary Theories of Art, Technology, and Consciousness* (1 edition). Berkeley: University of California Press.

Barthes, R. (1987). *Image Music Text* (New Ed edition). London: Fontana Press.

Barthes, R. (1991). *S/Z*. (R. Miller, Trans.). New York: Farrar, Straus & Giroux Inc.

Bateson, G. (1980). *Mind and Nature* (New edition edition). London: HarperCollins Distribution Services.

Baudrillard, J. (1994). *Simulacra and Simulation*. (S. Glaser, Trans.). Ann Arbor: University of Michigan Press.

Behar, I, (2016) *Arte de Sistemas: Conceptual Art and Politics in Argentina.* Retrieved 30 April 2016, from http://www.artslant.com/ny/articles/show/43212

Bennett, J. (2009). *Vibrant Matter: A Political Ecology of Things*. Duke University Press Books.

Bertalanffy, L. V. (2003). *General System Theory: Foundations, Development, Applications* (Revised edition edition). New York: George Braziller Inc.

Bigaj, T. (2012). *Metaphysics: A guided tour for beginners*. United States: CreateSpace Independent Publishing Platform.

Bogost, P. I. (2012). *Alien Phenomenology, or What it's Like to be a Thing*. Minneapolis: University of Minnesota Press.

Bourdieu, P. (1993). *The Field of Cultural Production: Essays on Art and Literature* (First Edition edition). Cambridge: Polity Press.

Bourriaud, N. (1998). *Relational Aesthetics*. France: Les Presse Du Reel.

Brown, P., Mason, C., Gere, C., & Lambert, N. (Eds.). (2009). *White Heat Cold Logic: British Computer Art 1960-1980*. Cambridge, Mass: MIT Press.

Bryant, L. R. (2011). *The Democracy of Objects*. Ann Arbor, Mich: MPublishing, University of Michigan Library.

Burnham, J. (1982). *Beyond Modern Sculpture*. New York: George Braziller Inc.

Burnham. J. (1970) *Software. Information Technology: Its New Meaning for Art*, exhibition catalogue, The Jewish Museum, New York

Burnham, J., Ragain, M., & Haacke, H. (2015). *Dissolve into Comprehension: Writings and Interviews, 1964-2004*. Cambridge, Massachusetts: MIT Press.

Callon. M. (1986), *Some elements of a sociology of translation: domestication of the scallops and the fishermen of St Brieuc Bay*. Retrieved 30 April 2016, from http://www.vub.ac.be/SOCO/tesa/RENCOM/Callon%20(1986)%20Some%20elements%20of%20a%20sociology%20of%20translation.pdf

Capra, F. (1997). *Web of Life: A New Synthesis of Mind and Matter* (New Ed edition). London: Harpercollins Uk.

Capra, P. F., & Luisi, P. L. (2014). *The Systems View of Life: A Unifying Vision*. Cambridge: Cambridge University Press.

Carey, J. W., & Adam, G. S. (1988). *Communication as Culture, Revised Edition: Essays on Media and Society* (1 edition). New York: Routledge.

Chorley, R. J., & Kennedy, B. A. (1971). *Physical Geography: A Systems Approach*. London: Prentice Hall.

Cilliers, P. (1998). *Complexity and Postmodernism: Understanding Complex Systems* (1 edition). London ; New York: Routledge.

Danto. R. (1964) *The Art world*, The Journal of Philosophy, Volume 61, Issue 19, American Philosophical Association Eastern Division Sixty-First Annual Meeting, 571-584.

Darboven, H. (1968) *Artist's statement* Retrieved 16 April 2017, from https://artiststatements.wordpress.com/2016/02/02/hanne-darboven/

Dawkins, R. (2016). *The Selfish Gene: 40th Anniversary edition* (4 edition). New York, NY: OUP Oxford.

Debord, G. (2009). *Society of the Spectacle: Written by Guy Debord, 2009 Edition, Publisher: Soul Bay Press*. Soul Bay Press.

Delanda, M. (2006). *A New Philosophy of Society: Assemblage Theory And Social Complexity* (Annotated edition). London ; New York: Continuum.

Delanda, M. (2010). *Subjects & objects, together or apart*… Retrieved 16 April 2017,

http://blog.uvm.edu/aivakhiv/2010/04/09/subjects-objects-together-or-apart/

Delanda, M. (2016). *Assemblage Theory*. Edinburgh: Edinburgh University Press.

Deleuze, G., & Guattari, F. (2013). *A Thousand Plateaus*. London: Bloomsbury Academic.

Dickinson, G. (2006). *Ecosystems* (2 edition). London ; New York: Routledge.

Doob, P. R. (1992). *The Idea of the Labyrinth from Classical Antiquity Through the Middle Ages* (New edition edition). Ithaca u.a: Cornell University Press.

Dudhwala, F. (n.d.). What is Actor-Network Theory? Retrieved 16 April 2017, from https://www.academia.edu/542543/What_is_Actor-Network_Theory

Eco, U., & Robey, D. (1989). *The Open Work*. (A. Cancogni, Trans.). Cambridge, Mass: Harvard University Press.

Eldridge, J. E. T. (1981). *Recent British Sociology*. London: Palgrave.

Fisher, M. (2009). *Capitalist Realism: Is There No Alternative?* Winchester: O Books.

Fisher, M. (2014). *Ghosts of My Life: Writings on Depression, Hauntology and Lost Futures*. Winchester (UK) ; Washington (USA: Zero Books.

Fox, W. (1990). *Toward a Transpersonal Ecology: Developing New Foundations for Environmentalism* (New edition edition). Totnes, Devon: Resurgence Books.

Fukuyama, F. (1992). *By Francis Fukuyama The End of History and the Last Man*. The Free Press.

Gardner, K. (2012). *Discordant Development: Global Capitalism and the Struggle for Connection in Bangladesh*. London: Pluto Press.

Gere, C. (2006). *Art, Time and Technology* (English Ed edition). Oxford ; New York: Berg Publishers.

Gell, R. (1998). *Art and Agency: An Anthropological Theory*. Oxford ; New York: Oxford University Press.

Gibson, W. (2010, August 31). Opinion | Google's Earth. *The New York Times*. Retrieved 16 April 2017, from https://www.nytimes.com/2010/09/01/opinion/01gibson.html

Ginn, F. (2015). When Horses Won't Eat: Apocalypse and the Anthropocene. *Annals of the Association of American Geographers*, *105*(2), 351–359. https://doi.org/10.1080/00045608.2014.988100

Glimcher, M. (2005). *Logical Conclusions - 40 Years of Rule-based Art*. New York City: Pace Wildenstein.

Gross, D. T., Konig, R., & Schmidt, S. (2011). *World and System: Contemporary Art Between Analysis, the Search for Meaning and Dilemma*. (G. Porstmann & J. Schmidt, Eds.) (Bilingual edition). Nürnberg: Verlag fur moderne Kunst Nurnberg.

Grusin, R. (Ed.). (2015). *The Nonhuman Turn*. Minneapolis: University of Minnesota Press.

Hagen, B. (2008). *Teaching ECOLOGY DURING THE ENVIRONMENTAL AGE, 1965-1980*. Environmental History, 13, 704–723.

Halsall, F. (2008). *Systems of Art: Art, History and Systems Theory* (1st New edition). Bern ; Oxford: Verlag Peter Lang.

Hardin, G. (1968). T*he Tragedy of the Commons*. *Science,162* (3859), 1243-1248. Retrieved from http://www.jstor.org/stable/1724745

Harding, S. (2009). *(Animate Earth: Science, Intuition and Gaia) By Dr. Stephan Harding* (Second edition). Green Books.

Harman, G. (2016). *Immaterialism: Objects and Social Theory*. Malden, MA: Polity Press.

Hartmann, B., & Boyce, J. K. (1984). *A Quiet Violence: View from a Bangladesh Village* (1 edition). London: Zed Books.

Harvey, G. (Ed.). (2015). *The Handbook of Contemporary Animism* (1 edition). London New York, NY: Routledge.

Hayles, N. K. (1999). *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics* (74th edition). Chicago, Ill: University of Chicago Press.

Heiser. R. (2010). *Analyze This*. Retrieved 4 February, 2018, from https://frieze.com/article/analyze?

Hornsby, J. (2001). *Simple Mindedness: In Defense of Naive Naturalism in the Philosophy of Mind* (New Ed edition). Cambridge, Mass.: Harvard University Press.

Ibrahim, A. (2018). *The Rohingyas: Inside Myanmar's Hidden Genocide* (Revised edition). S.l.: C Hurst & Co Publishers Ltd.

Kurgan, L. (2013). *Close Up at a Distance: Mapping, Technology, and Politics*. Brooklyn, NY: MIT Press.

Krauss, R. (1979). *Sculpture in the Expanded Field*. *October, 8*, 31-44. doi:10.2307/778224

Landow, P. G. P. (Ed.). (1991). *Hypertext: The Convergence of Contemporary Critical Theory and Technology*. Baltimore: The Johns Hopkins University Press.

Latour, B. (1993). *We Have Never Been Modern*. (C. Porter, Trans.). Cambridge, Mass: Harvard University Press.

Latour, B. (1995). On recalling ANT | bruno-latour.fr. Retrieved 19 September 2017, from http://www.bruno-latour.fr/node/630

Latour, B. (1996). On actor-network theory: A few clarifications. *Soziale Welt*, *47*(4), 369–381.

Latour, B., & Weibel, P. (Eds.). (2005). *Making Things Public: Atmospheres of Democracy*. Cambridge, Mass. : Karlsruhe, Germany: MIT Press.

Lee, P. M. (2006). *Chronophobia: On Time in the Art of the 1960s*. Cambridge, Mass; London: MIT Press.

Levi-strauss. (1968). *The Savage Mind*. Chicago: University of Chicago Press.

Lovelock, J. (2016). *Gaia: A New Look at Life on Earth* (2 Reprint edition). Oxford, United Kingdom: OUP Oxford.

Luhmann, N. (2000). *Art as a Social System*. (E. M. Knodt, Trans.). Stanford, Calif: Stanford University Press.

Luhmann, N., Baecker, D., & Knodt, E. M. (1996). *Social Systems*. (J. Bednarz, Trans.). Stanford, Calif: Stanford University Press.

Luisi, P. L. (2006). *The Emergence of Life: From Chemical Origins to Synthetic Biology* (Reissue edition). Cambridge: Cambridge University Press.

Malik, S., Cox, C., & Jaskey, J. (2015). *Realism Materialism Art*. Berlin: Sternberg Press.

Marston, S. A., Jones, J. P., & Woodward, K. (2005). Human geography without scale. *Transactions of the Institute of British Geographers*, *30*(4), 416–432. https://doi.org/10.1111/j.1475-5661.2005.00180.x

Maturana, H. R. (1979). *Autopoiesis and Cognition: The Realization of the Living* (Softcover reprint of the original 1st ed. 1980 edition). Dordrecht, Holland ; Boston: D. Reidel Publishing Company.

Meillassoux, Q., & Badiou, A. (2009). *After Finitude: An Essay on the Necessity of Contingency* (Reprint edition). London ; New York: Continuum.

Meltzer, E. (2013). *Systems We Have Loved: Conceptual Art, Affect, and the Antihumanist Turn*. Chicago ; London: University of Chicago Press.

Morowitz, H. (2004). *The Emergence of Everything: How the World Became Complex* (New Ed edition). New York: Oxford University Press, U.S.A.

Morowitz, H. (2009). *Beginning of Cellular Life: Metabolism Recapitulates Biogenesis*. Yale University Press, New Haven & London.

Morton, T. (2012). *Ecological Thought* (Reprint edition). Cambridge, Mass.; London: Harvard University Press.

Morton, T. (2013a). *Hyperobjects: Philosophy and Ecology After the End of the World*. Minneapolis: University of Minnesota Press.

Morton, T. (2013b). *Realist Magic: Objects, Ontology, Causality*. Ann Arbor, Mich: MPublishing, University of Michigan Library.

Morton, T. (2016). *Dark Ecology: For a Logic of Future Coexistence*. New York: Columbia University Press.

Müller, M. (2015). Assemblages and Actor-networks: Rethinking Socio-material Power, Politics and Space. *Geography Compass*, *9*(1), 27–41. https://doi.org/10.1111/gec3.12192

Naess, A. (2003). *Ecology, Community and Lifestyle : Outline of an Ecosophy*. CAMBRIDGE UNIVERSITY PRESS.

Odum, E. P. (1971). *Fundamentals of Ecology* (3rd Revised edition edition). Philadelphia: Saunders College Publishing/Harcourt Brace.

Osborne, P. (2013). *Anywhere or Not At All: Philosophy of Contemporary Art* (1 edition). Verso.

Pianka, E. R. (1997). *Evolutionary Ecology* (5 edition). New York: Benjamin Cummings.

Pickles, J. (Ed.). (1995). *Ground Truth: The Social Implications of Geographic Information Systems* (1 edition). New York: Guilford Press.

Polkinghorne, D. (1983). *Methodology for the Human Sciences: Systems of Inquiry*. SUNY Press.

Popper, K. (2002). *Conjectures and Refutations: The Growth of Scientific Knowledge* (2 edition). London ; New York: Routledge.

Quaranta, D. (2013). *Beyond New Media Art*. Brescia: lulu.com.

Rambo, T., & Sajise, P. (1984). *An Introduction to human ecology research on agricultural systems in Southeast Asia*. College, Laguna, Philippines : Honolulu, HI: East-West Center.

Rheingold, H. (Ed.). (1995). *Millennium Whole Earth Catalogue*. San Francisco: HarperCollins,Australia.

Richer. G, (*1996*), *192 Farben,* Retrieved 30 April 2016, from www.gerhard-richter.com/en/art/paintings/abstracts/colour-charts-12

Robertson, P. (2012). *Themes of Contemporary Art: Visual Art After 1980* (3rd Revised ed. edition). New York ; Oxford: Oxford University Press, USA.

Saussure, F. de. (1990). *General Course in Linguistics*. (C. Bally & etc, Eds., W. Baskin, Trans.) (2nd Revised edition edition). London: Peter Owen Publishers.

Shakespeare, W., Watts, C., & Carabine, D. K. (1993). *Antony and Cleopatra* (New edition edition). Ware: Wordsworth Editions.

Shanken, E. (2002). Art in the Information Age: Technology and Conceptual Art. *Leonardo*, *35*, 433–438.

Shanken, E. (1998) *The House that Jack Built: Jack Burnham's Concept of "Software" as a Metaphor for Art* Retrieved 4 February 2018, from http://artexetra.com/House.html

Shanken, E. A. (2015). *Systems*. Cambridge, Massachusetts: MIT Press.

Shannon, C. E., & Weaver, W. (1963). *The Mathematical Theory of Communication*. Urbana: University of Illinois Press.

Shtromberg, E. (2016). *Art Systems: Brazil and the 1970s*. University of Texas Press.

Spradlin, W. W., & Porterfield, H.-U. (1984). *The Search for Certainty* (Softcover reprint of the original 1st ed. 1984 edition). New York: Springer.

Swyngedouw, E. (2010). Apocalypse Forever? *Theory, Culture & Society*, *27*(2–3), 213–232. https://doi.org/10.1177/0263276409358728

Swyngedouw, E. (2013). Apocalypse Now! Fear and Doomsday Pleasures. *Capitalism Nature Socialism*, *24*(1), 9–18. https://doi.org/10.1080/10455752.2012.759252

Tate. (n.d.). 'My Neck is Thinner than a Hair: Engines', Atlas Group, Walid Raad, 2000-3. Retrieved 4 February 2018, from http://www.tate.org.uk/art/artworks/atlas-group-raad-my-neck-is-thinner-than-a-hair-engines-t11912

Travers, J., & Milgram, S. (1969). An Experimental Study of the Small World Problem. *Sociometry*, *32*(4), 425–443. https://doi.org/10.2307/2786545

The Creation Myth, 1998 - Jason Rhoades. (n.d.). Retrieved 4 February 2018, from https://www.wikiart.org/en/jason-rhoades/the-creation-myth-1998

The Rose (I), 2008 - Cy Twombly. (n.d.). Retrieved 4 February 2018, from https://www.wikiart.org/en/cy-twombly/the-rose-i

The works – Centre Pompidou. (n.d.). Retrieved 4 February 2018, from https://www.centrepompidou.fr/en/Collections/The-works

Varela, F. J., results, search, Rosch, E., & Kabat-zinn, J. (2017). *The Embodied Mind: Cognitive Science and Human Experience* (revised edition edition). Cambridge, Massachusetts ; London England: MIT Press.

Vernallis, C., Herzog, A., & Richardson, J. (Eds.). (2015). *Oxford Handbook of Sound and Image in Digital Media* (Reprint edition). Oxford University Press.

Victory, 1984 - Cy Twombly. (n.d.). Retrieved 4 February 2018, from https://www.wikiart.org/en/cy-twombly/victory

Wallace, D. F. (1997). *Infinite Jest*. London: Abacus.

Well, R.G., (2017). *The War of the Worlds*. (D. Jones, Ed.). Oxford, United Kingdom: OUP Oxford.

Weed, E. (2004) *A Labyrinth of Symbols: Exploring "The Garden of Forking Paths"* Retrieved 4 February 2018, from https://www.borges.pitt.edu/sites/default/files/1808.pdf

Wohlleben, P. (2017). *The Hidden Life of Trees: The International Bestseller – What They Feel, How They Communicate*. S.l.: William Collins.

Youngblood, G. (1970). *Expanded Cinema*. New York, N.Y: E. P. Dutton.

Zimmer, C. (2013). *The Tangled Bank: An Introduction to Evolution.* Roberts and Company.

Appendix 1

The branches of Systems Art

The branches of Systems Art

This appendix briefly disaggregates systemic art, which developed in the first fold of systems into five interdependent categories of art production to demonstrate their diverse roots, intentions and trajectories. The literary critic and Marxist theorist Frederick Jameson described this period as one of transformation and suggested that,

> 'the Sixties did not end in an instant but extended until 1972-1974, and that the early Seventies encompasses the formal lessons and experiments of the Sixties while signaling, the pluralism associated with the Seventies in general. And Rosalind Krauss characterized the period as 'diversified, split and factionalized.' (Salvo, 2005, p. 12)

Systems Art personified this pluralism as it emerged from a diverse set of roots and through time has diversified to form and influence different branches of art and culture. More broadly within society systems and systems thinking may have become less discussed than in this period, in large part due to their ubiquity as the de-facto modus operandi. Thus, it is instructive to return to examples of work developed within this the Primary Fold of systems to consider some of the ideas, which were circulating, and whether these messages require re-circulation within the art system.

Many of the texts that I have drawn from whilst considering the foundations of systemic thinking within art have assumed an art historical narrative, but they have not necessarily disaggregated the work in terms of 'motivation', of the artist. That is, they have imposed an ‘a posteriori' or retrospective top-down description of what is observed as having taken place; whereas the individual artists involved would not necessarily recognise these overarching descriptions, as they understand themselves as individual actors, and would, therefore, describe their actions in upwardly causal terms. That is, the artists negotiating these ideas would not necessarily have seen themselves as ‘systems artists', or ‘conceptual artists' at the time, but would be concentrated on their practice. Instead, similarities between practices would emerge (upwardly causal) over time, and then commentators would acknowledge patterns in the shared ideas and approaches to production and then impose a (downwardly causal) category, such as ‘Systems Art’.

Inevitably with the distance of time, it is easier to impose categories, as there have been art-historical, institutional and market ‘shakedowns', in which the narratives are simplified along the axes of culture, time and space. Thus, artists are inevitably

excluded, as they do not fall within the intersections of these vectors. The wonderful diagrammatic paintings of Hilma af Klint, for example, lie outside of the category of Systems Art, as she was operating fifty years before 'Systems Art' was 'invented'. The work though has a hermetic quality, which suggests an underlying systemic structure. And if time were foldable, this work could sit alongside the later esoteric ideas of Jack Burnham, one of the key figures in Systems Art. This example demonstrates the potential poverty of historically reducing everything to spatiotemporal narratives, as interesting connections are missed. In Chapter 5, two incredibly powerful conceptions of relational or system thinking are introduced, Actor-Network Theory, (ANT) and Assemblage Theory, which allow for more flexible relations to be articulated. ANT, for example, allows for network lines to be drawn between two actors that share a relationship, despite a spatiotemporal or cultural distance. So, a direct line could be drawn between af Klint, and Burnham binding them as encoders and decoders of mystic systems. Whereas Assemblage allows for reterritorialisation in which the systems art category is momentarily reconfigured to include these outliers.

During the literature review of Systems Art history there was a tacit assumption, in many of the texts, that there is a shared understanding of what constitutes Systems Art, System Thinking and System Aesthetics. This shared understanding is not borne out when considering specific artists and artworks labelled 'Systems Art'. The exhibition 'Open Systems: Rethinking Art c. 1970', for example, was organised in terms of the art object by the curator Donna De Salvo; with the work considered and classified in relation to traditional art categories, such as 'minimalism', 'serialism', and 'space'. Whilst this was a very useful way of understanding the presented objects it did not penetrate the deeper roots of systems thinking out with the art ecosystem and consider how the broader systemic ideas prevalent at the time informed the production of the work.

The exception to this narrowness of focus is the recent book, Systems, (Shanken, 2015) in which the editor selected a wide-ranging collection of texts from artists, theorists and critics who were either involved in Systems Art directly or influenced it on a theoretical or critical level. Shanken structures these texts into four areas of systemic influence: 'Cybernetic art, Architecture and Design', 'System Aesthetics', 'Generative Systems' and 'Environmental and Social Systems'. 'Cybernetic art, Architecture and Design' (2015, pp. 62–109) covers texts, art and design that directly address the ideas of Cybernetics on an explicit level, as in the work of Nam June Paik and Roy Ascott. 'System Aesthetics', (2015, pp. 110-149) covers the application of system thinking to

art theory and criticism, and includes the seminal texts of Jack Burnham, as well as Shanken's influential papers on Burnham, conversations with Hans Haacke and an extract of Francis Halsall's Systems of art, (2008). 'Generative Systems', (2015, pp. 150-187) covers texts that consider art that applies rules in the production process of work, such as Manfred Mohr, (1971), and Brian Eno, (1976). While the final category of 'Environmental and Social systems', (2015, pp. 188–228), includes texts from James Lovelock, (1989), Pierre Bourdieu, (1983), and Niklas Luhmanns, (1995), and considers the application of systems thinking in the physical and social environments. Although Systems, (2015), is a well-structured collection of texts, which demonstrates the influence of systems thinking and practice within art, theory and design, the intention of this appendix is narrower. As the aim here is to consider the disparate influences that have acted upon the artists that fall under the systems banner, and how this has informed my practice.

Thus, with this limitation in mind, the categories of Systems Art proposed here are Cybernetic Systems, Formal Systems, Language Systems, Ecological Systems and Social Systems. These five branches of systems art discussed here, which while sharing some underlying cybernetic foundations are sufficiently different to be considered as distinct areas within systems art. Each of these branches, except for 'Cybernetic Systems', have been developed here, to structure this review and would not have been recognised as distinct categories of systems art during the period of interest. Further, these branches of systems art are not entirely independent, and the work of one artist could overlap several of these branches. These branches are, though, a useful way of understanding the different underlying roots of systems art, the various motivations of the artists involved and what can still be usefully distilled from the original system's fold.

In addition to these five branches there are two interconnected categories of work that have at times fallen under the banner of Systems Art, which will not be discussed in any detail here. Firstly, there is the technologically driven Media Art, which encompassed video, computer graphics, cyborg art and artificial life. Secondly, and related to the Media Art category is work which employed 'systems', 'serial systems,' and 'systems aesthetics', purely as a metaphor, without the underlying principles of system thinking or information exchange being understood by the critic, or present in the work. (Lee, 2006, p. 68) As Lee notes, we would now recognise both these sorts of work, the technically driven experiments and the use of technology and 'systems as metaphor' as generally falling within the purview of Media Art, as opposed to

Contemporary art. However, this work developed within the art fold during a period of tectonic shifting, as many of the tenants of modernism were being challenged and even replaced by Conceptualism, the Expanded Field, Postmodernism, and the post-medium 'condition' (Krauss, 2006).

Although the roots of such technological work could be traced back to 'Experiments in art and Technology' (E.A.T.) the radical collaboration between artists and engineers and a reading of Marshall McLuhan's 'media and message', (McLuhan & Fiore, 2008) much of the subsequent Media art has got lost in either the tangle of technology or the tangle of images and messages being transmitted by the technology. A criticism that can be levelled at Media Art is that the work can be spectacular, in technical and visual terms, deploying the tropes of cybernetics, technology and systems, but at the expense of criticality. Quaranta, (2013) develops a clear defence of this work arguing that active engagement in new and complex methods and technologies requires a significant investment of time to master and this could explain, in part, the sidelining of the conceptual, critical or aesthetic concerns. This argument, however, is insufficient to explain why much technology-based work is indistinguishable from the wider circulation of images, social media and the Internet. That is, without a critical distance, art, which employs technology, such as the Internet, social media, and mass media, is merely an extension of the spectacle and contributes to our alienation from reality. It is interesting that at the time technology-driven art was emerging Guy Debord published 'Society of the Spectacle', (1968), which presciently anticipated the spectacular future mediated by the hyper-system of the Internet.

> 'The spectacle presents itself simultaneously as society' itself, as a part of society', and as a *means of unification.* As a part of society', it is the focal point of all vision and all consciousness. But due to the very fact that this sector is *separate*, it is in reality the domain of delusion and false consciousness: the unification it achieves is nothing but an official language of universal separation.The spectacle presents itself simultaneously as society' itself, as a part of society', and as a *means of unification.* As a part of society', it is the focal point of all vision and all consciousness. But due to the very fact that this sector is *separate,* it is in reality the domain of delusion and false consciousness: the unification it achieves is nothing but an official language of universal separation'. (2009, p. 24)

This dialectical tension continues to be played out today between Media Art, which has mastered the technological materials, (and one could argue has an affective relationship with the digital), and a Contemporary Art that comments about such materials, but more from the position of an outsider, critic or even consumer. This

distinction and tension between ‘Media Artist-as-producer’ and ‘Contemporary Artist-as-critic’ is illustrated in contemporary work, such as ‘Post-Internet Art'; as these works operate at an unusual intersection between desire, ambivalence and nostalgia regarding the digital. These works tend to have an explicit nostalgia for aesthetics of the Open Fold of systems and in particular the aesthetics of early computer graphics. The work suggests a mix of nostalgia for a time when the digital was contained mixed with a mild distaste or ironic distance. Regardless of intention many of the works succeed in reflecting on the individual’s collusion with systems within society, such as social networks and the consumption of images. Thus, the better work accurately reflects the recursive self-absorbed role of the subordinated consumer within the image, Capital and social systems; a state anticipated by Debord's Spectacle. As Martin Jenkins summarizes,

> ‘The spectacle is a social relation between people that is mediated by an accumulation of images that serve to alienate us from a genuinely lived life. The image is thus an historical mutation of the form of commodity fetishism’. (Jenkins cited in Debord, 2009, p. 24)

Thus, Media Art’s intentions are difficult to read, as although they have mastered the contemporary technologies, it sometimes appears to come at the expense of critical distance. This perceived lack of criticality is to some degree understandable in the first wave of systems, as the impacts of the technology were difficult to comprehend. This lack of distance and criticality is understood in this passage from Jasia Reichardt in *Cybernetics, Art, and Ideas*

> ‘At the one end artists seek technological means to develop or amplify their ideas and projects: at the other end artists whose work is quite removed from what technology implies have been influenced by its jargon. Cybernetics as a descriptive term has been applied to sculptures operating on a feedback system as well as assemblages using cogs and wheels. ‘Stochastic' and ‘aleatory' have been used to describe paintings which incorporate chance images and ‘topology' for pictures with obscure perspective. The terms ‘information theory', ‘metaprograms', ‘strategy', ‘entropy', ‘hardware' and ‘real time', are to be found in manifestos which have little to do with the sort of art to which they could possibly apply. These terms serve to create an atmosphere rather than convey concrete information. Their use demonstrates the artist's desire and need to be involved in a world of human aspirations, other than those dealing with art.' (1971, p. 16)

Sol LeWitt, a key systems artist, was keenly aware of the distinctions between conceptually driven systems art and what he described as ‘electronic art', which referenced technology uncritically. He noted this difference between conceptually and technology motivated work in his essay *Paragraphs of Conceptual art*, (1967), in which

he famously described conceptual art as ‘a machine that makes the art’. In contrast he saw the weakness of technology driven art as focused on the novelty of new materials and processes, stating,

> ‘new materials are one of the great afflictions of contemporary art.. The danger is, I think, in making the physicality of the materials so important that it becomes the idea of the work (another kind of expressionism).’ (LeWitt, 1967).

Thus, the important distinction that needs to be made clear here is that the five branches of Systems Art described here are not technologically determined in this way; and whilst systems artists may have employed technology and digital media the underlying ideas are systemic and conceptual. Thus, a broad range of work from this period onward can be considered as systemic in nature. Lee in her expansive assessment of the operation of time within the first fold, *Chronophobia: On Time in the art of the 1960s* suggested that 'conceptual art and its linguistic propositions, site-specific work and its environmental dimensions, performance art and its mattering of real time, minimalism even,' can all be rethought in systems terms, and this forms the focus of this appendix. (Lee, 2006 p. 68)

Cybernetic Systems

From a European perspective, Roy Ascott is seen as one of the founding fathers of cybernetic art, and his work and writing have established him as one of the key thinkers in the crossroads between art and Media Art. Although his work has a strong technological aspect, Ascott reasserts the original biological roots of cybernetic thinking and notes that his first experience of cybernetic ideas was through the D.W. Thompson's 1917 Biology text *On Growth and Form*. (Brown et al., 2009, p. 10) He also points to other strands of systems thinking available to artists during this period, such as the Process philosophy of Whitehead in *Process and Reality*, (Whitehead, 1979) and the broader holistic thinking of Gregory Bateson in *Steps towards an Ecology of mind*, (Bateson, 1972), which is mentioned in chapter 2 on ecosystems.

Crucially, however, from the perspective of this thesis Ascott developed a sense that the systemic nature of art extended beyond the art object to include other participants in the process of art. As he notes,

> 'I could see that the artwork was a system arising from a process, the system including the artist, the artwork, and the observer, coupled in a semantic relationship, where the aesthetic experience emerged from the interaction of these three elements.' (Ascott cited in Brown et al., 2009, pp. 11–12)

This systematic, or behaviourist approach to the understanding of art and more broadly human interaction was captured in his 1967 manifesto,

> 'To discuss what one is doing rather than the artwork that results, to attempt to unravel the loops of creative activity, is, in many ways, a behavioural problem. The fusion of art, science and personality is involved. It leads to considerations of our total relationship to a work of art, in which physical moves may lead to conceptual moves, in which Behaviour relates to Idea... An organism is most efficient when it knows its own internal order.' (Ascott cited Brown et al., 2009, p.12)

Ascott's writing was influential during this period and has remained so. His anthology of work, *Telematic Embrace*, (2008), bringing together his key texts, on cybernetics in art demonstrating his wide-ranging understanding of systems within society and art. Ascott's work as an artist evolved from two forms of Systems work. Firstly, there were the early systemic 'Change-Paintings' (1959), which were procedural and aesthetically driven and these would more correctly fall into the category of Formal Systems; while the 'Analogue Structures', (1964) dealt with the key cybernetic concerns of interaction and change. Whilst the later work, *Pillar of Information*, was a more direct collaboration

with computer science, and dealt directly with issues surrounding the exchange of information. This work is interesting on a number of levels, not least as it effectively anticipated online search engines, such as *Google*, and also because it is an example of an artwork which can operate as both a critical tool in the Contemporary art sense, and a useful tool in culture. Stanley Matthews in a review of the work, commented that the 'Pillar of Information foreshadows in many ways the more recent prismatic theory of knowledge developed in the late 1980s by Gilles Deleuze and Felix Guattari'. (Brown et al., 2009, p.15)

Beyond Ascott 'Cybernetic Systems' encompasses work and ideas in which the application of cybernetics principles, including the concept of information exchange, is both implicit and explicit. Key artists, whose work could be categorised as cybernetic, also included Nam June Paik, Les Levine, Hans Haacke and Jack Burnham. As well as his important writing Burnham organised one of the seminal exhibitions that dealt with cybernetics and systems, *Software*, which delivered two explicit messages. Firstly, this event made explicit that art was relational and about information exchange. Secondly, as computers and technologies were being employed to transact information exchanges in society, then art must engage with these technologies.

Other notable cybernetic exhibitions were *Cybernetic Serendipity: The Computer and the Arts*, curated by Jasia Reichardt at *London Institute of Contemporary Arts*, (ICA) 1968; *Information,* curated by Kynaston McShine at the *Museum of Modem Art*, New York, (1970); *When Attitudes Become Form, Concepts, Processes, Situations, Information*, Kunsthalle, Bern, (1969), and 'Systems', Whitechapel Art Gallery, London, (1972). The curatorial perspectives represented by these exhibitions concerning cybernetics, computing and systems ranged from the ambiguously cautious in the case of *Software*, to the positive and uncritical in the case of *Cybernetic Serendipity*. The ideas and perspectives represented in these exhibitions drew inspiration from the work of the systems theorists Ludwig von Bertalanffy, Norbert Wiener, John von Neumann, and Claude Shannon. Also the speculative systems thinking of Buckminster Fuller and biological systems thinking of Gregory Bateson, as well as the expanded thinking of Gene Youngblood, were influential, particularly through their contributions to the systemic journal *Radical Software*, (1970-1974). (Shanken, 2015)

The main contributions of Cybernetic systems to my practice and understanding of Systems Art can be summarised as follows.

1. Shift in focus from the object to the Process

   As proposed by Burnham's writing and his curated exhibition, he saw a shift in both society and art from objects to the processes of interaction between objects.

2. Relationalism

   Once the art object is decoupled from a single physical entity, attention can be refocused on the relationship between things, as this is where the action happens.

3. Information

   The focus on information is a consequence of the shift from object to processes and relations, and draws from Shannon and Weaver's 'Model of Communication'. This is discussed in chapter 3 to demonstrate how art is the product of information transported through the system combined with the meanings generated through its reception.

4. Distribution

   Once the art object has been expanded to include both the objects, their processes and relations it effectively becomes a system of things. This idea is something early systems artists such as Burnham and Ascott understood from Cybernetics and the systems biology of Gregory Bateson.

Formal Systems

The second category, Formal Systems is an understanding of systems in terms of rule-based art, design rules and aesthetics, which has its roots in the work of Rodchenko, via Josef Albers through to Abstract Expressionism. This category of work would include the minimalism of Jo Baer, Agnes Martin, and Robert Ryman, for example, who explored the formal possibilities of reduced form and repetition, (Glimcher, 2005), along with the Systems Group in Britain, including Jeffrey Steele who produced modular, constructivist-inspired work. (A Rational Aesthetic, 2008)

Formal Systems is not a category of Systems Art that would have been recognised during this period, but it is a useful way of considering the history and work of the Artists that dealt with the aesthetic dimension of Systems Art through the application and negotiation of rules. In the catalogue for the expansive group exhibition on systems-based art, *Logical Conclusions: 40 Years of Rule-Based art* at Pace, New York, (2005) Marc Glimcher summarised rule-based art as,

> 'art created utilizing one or more logic-based systems to direct the design and creation of the object. Their foundation may be mathematical, such as those based on geometric and number theories. Or, they may be founded in logic; for instance, solipsism and other tautological constructs. And finally, there are applications of game theory, in which the artist forces the art to conform to certain arbitrary (if personally meaningful) rules.' (Glimcher, 2005, p. 7)

Although rule-based systems art emerged as an essentially minimalist and abstract movement in the 1960s its roots can be traced through Abstract Expressionism, and back through to the geometric abstraction of Kazimir Malevich and Alexander Rodchenko. Glimcher noted this lineage highlighting Rodchenko's spatial constructions, which he described in his book, *Laboratory Course through art from Painting to Constructive-Spatial Forms towards an Industrial Initiative*. (Glimcher, 2005,). This is a very early, if not the first recorded example of an artist articulating explicit 'design rules' for the production of work, which he called spatial constructions. In this text, Rodchenko outlined his strictly procedural methodology as follows.

> These are the latest spatial constructions. I developed them experimentally. The exclusive purpose was to bind the constructor to the law of expediency of the forms used, to make him uphold their lawful coherence as well as to demonstrate universality, so that one can build out of these identical shapes all kinds of constructions for various systems, types and applications. In these works, which are real constructions, I promulgate a mandatory condition for the

> future industrial builder: Nothing random or uncontrolled. Everything has to be reduced to universal initiative; it has to be simplified, generalised. (Rodchenko cited in Glimcher, 2005, p. 8).

This approach anticipates the rule-based art of the 1960's and reads very similar to Sol LeWitt's, *Sentences on Conceptual art*, (1969), published some 43 years later. Much of LeWitt's work falls into this category of Formal Systems, as they are visual works derived from the application of rules; and his 'sentences' marked the transition from Minimalism to Conceptualism. (Glimcher, 2005)

As well as the application of rules in the production of visual aesthetic work, there were several artists that focussed on measurement either as a formal structural device as seen in the earlier Constructivism of Malevich and Piet Mondrian, or as a conceptual device in the work of Mel Bochner, Hanne Darboven, Christine Kozlov and On Kawara. This aspect of the Systems Art was foregrounded in the 2005 Exhibition *Open Systems* at Tate Modern curated by Donna De Salvo.

Although Mel Bochner is possibly associated more with language driven conceptual art he also had 'measurement' and its ambiguous role in science and culture as a focus. This sense that the measurement of things and systematising of the world is not contributing to knowledge of the world, but is in-fact contributing to the noise that disrupts ones understanding of the world feels very contemporary. As Morton notes, 'too much information equates to noise' (Morton, 2012, p. 30) Bochner's *Measurement: Room (no.14)*, for example, (1969) and re-installed in the 2005 exhibition *Open Systems* can be understood as a mediation on the role of metrics in spatial terms. In this work, Bochner enclosed a room of a gallery by marking out its proportions with black tape and numbers on the walls. De Salvo describe the role of measurement in this work as follows,

> 'the mediating system of measurement create(d) distance between the viewer and what they were seeing. ..The measurements not only serve to make the viewer aware of his or her surroundings, but to make them self-consciously aware, that they are now the subject.' (Salvo, 2005, p. 19)

Bochner understood the limitations of deconstruction in these terms when he noted,

> 'Measurement is one of our means of believing that the world can be reduced to a function of human understanding. Yet, when forced to surrender its transparency, measurement reveals an essential nothingness. The yardstick does not say that the thing we are measuring is one yard long. Something must

> be added to the yardstick in order to assert anything about the length of the object. This something is a purely mental act... "an assumption"'. (Salvo, 2005, p. 19)

This statement captures the dual nature of Systems Art, which is both optimistic and pessimistic concerning our ability to measure and understand the experienced world. Morton expands on this view of measurement with an updated version of Aristotle's maxim, 'The more you know, the more you know you don't know', as follows,

> 'On the one hand, our world expands as our knowledge grows. But on the other hand, it shrinks: things are "less" than we thought they were. We discover that our more detailed understanding of how things connect with each other results in a loss of a sense of reality. A void opens up in our social and psychological space'. (Morton, 2012, p. 36)

The main contributions of Formal Systems to my practice and understanding of art can be summarised as follows.

1. Proceduralism

   The primary contribution from formal systems is the generation and application of system rules for the creation of new works. Thus, the conceptual thinking, and to some degree, the planning takes place at the start of the work, and then the artist can participate and manage the unfolding of the work by following the rules.

2. Aesthetic dimension

   This reliance on the rules allows the artist to enjoy the aesthetic discoveries, as the rules unfold, and in that sense, such work is a continuation of modernism, even though the work is structured in conceptual terms.

3. Praesens affects

   As noted the rules are developed 'a priori', but the aesthetic and affective experiences emerge during the application of the rules and then afterwards when considering the work that has emerged from the rules. Thus, there are three phases of experience for the artist, the conceptual phase followed by two interrelated phases of reflection. These two phases could be described as 'a posteriori' to describe the experience of seeing the completed work, and 'praesens' to describe experiencing the work as it emerges in the present. Like the German present tense Präsens, praesens is about the 'momentary now', which is one of the primary experiences as the painting or work unfolds.

4. Mapping difference

   Another key aspect of Formal Systems is the methodical repetition of rules to make and re-make work in order to reveal differences and deeper levels of structure and pattern that are not formally articulated in the rules of production. This process of revelation is at the heart of phenomenological and ecological understanding, and Bateson's, 'Difference that makes the difference', is invoked throughout the thesis in relation to systems thinking.

Language Systems

Language Systems, as a category, is work that has been de-materialised down to the essential conceptual idea, and its communication through language. Further, it is work that operates within the structures of language as a system in its own right, and as such draws from the work of Structuralism, Saussure and Barthes. These are conceptual works, which are either ideas reduced to language, or language itself is the subject of investigation.

The ‘Art & Language' group, for example, worked strictly with conceptual ideas communicated through texts. Their work was research-driven, with a focus on the idea of painting, for example, and the resultant works were refined down to key statements on the subject of research. Charles Harrison, one of the founding members of the group, described it as follows,

> ‘The idea of ideas as discursive items, as art... required that the hypothesized object be seen not as ‘the art’, but as the object of an inquiry for which the status of art was more-or-less strategically claimed. The conviction that characterized Art & Language was that it was the inquiry which had to be the work and which therefore had to become 'the work'. (Harrison, 2002, p. 10)

Other important artists that focused on language as both medium and system of interest included, Lawrence Weiner, Robert Barry, and Joseph Kosuth. Rorimer suggested that by focusing on language as the primary medium, these artists could remove the authorial presence usually associated with traditional art materials. She states,

> ‘In the process, their work broke from the defining framework of painting and mold of sculpture. Because of language's unique capacity to be the very substance of the message it delivers, works by these artists are congruent with that of which they speak, since what they are and what they are of coincide.’ (Rorimer, 2004, p. 76)

Joseph Kosuth is particularly interesting in art historical terms, as many of his works seek to map the space between the material and their representation in the image, and through to their signification in language, anticipating Bruno Latour’s, distinction between culture and thing, or ‘what is sign from what is thing'. (Latour, 1993, p. 99) Thus in a series of works Kosuth presented something three times; as the material object, a photograph of the object and a textual description of the object.

The main contributions of Language Systems to my practice and understanding of art can be summarised as follows

1. Art as research

   The methods employed by Art & Language demonstrate an explicit research attitude, and I recognise this from my previous work in environmental science and information science. My project *Sly Lost Games*, for example, was consciously approached as a research exercise, and the aesthetic aspect of the work was a secondary factor.

2. Language as a system to investigate an idea

   This work demonstrated the power of reducing the focus of enquiry down to a single system, such as language. In particular, the work of Art & Language, Joseph Kosuth, and Robert Barry demonstrate that such systems are still complex open systems, and the resultant art experiences are emergent and unexpected. Thus although the work is reduced to a narrow concept the experience of the work is not captured by a narrow description of the concept. My project, *Fabled Eye Accommodates Revelation*, (FEAR), for example, demonstrates this principle as the emergent messages generated from the system are not captured within a narrow conceptual description of the work.

3. Painting is conceptual

   The language driven work of Art & Language paradoxically supports the idea of painting, by underlining its conceptual basis. This was understood by Kosuth who stated in 1969 when he stated,

   'Being an artist now means to question the nature of art. If one is questioning the nature of painting, one cannot be questioning the nature of art. If an artist accepts painting (or sculpture) he is accepting the tradition that goes with it. That's because the word art is general and the word painting is specific.. All art (after Duchamp) is conceptual (in nature) because art only exists conceptually.' (Kosuth cited in Harrison, 2002, p. 62)

4. Language is play

   Language is to some degree a predefined system, and within its rules, there is freedom for playful experimentation. This is demonstrated in my projects *Sly Lost Games*, and *FEAR.*

Environmental Systems

Environmental Systems, describes the nascent holistic ecology movement, which foregrounded the interdependence of things in nature and society, and draws from the same ideas and energy as the ecosystem model discussed in Chapter 2.

Environmental Systems Art is not a category that would have been recognised during this period, but it is a useful way of considering the history and work of the artists that dealt with the environment and ecology in systemic terms. Although the artists within this category are diverse as the influences acting upon their work there are some underlying concerns that usefully bind them together for this discussion. These concerns include sculptural minimalism, conceptualism, systems thinking and an ecological view of the world, which was emerging across culture in the 1960's. From a contemporary perspective, we can also consider their affinity in terms of their interest in space and time; energy exchanges in systems, and the affective and performative use of the body in the world**.**

This category has been named as environmental, as opposed to ecological as there are distinct taxonomic and historical differences in meaning between these two terms when applied to either nature or art. From a 20th Century Western art perspective, it can be argued that an environmental understanding of art emerged prior to an ecological understanding of art. As will be discussed here 'environmental' in art terms relates to the sense that a work of art can operate within a wider environment or function as an independent environment. This is an inherently sculptural definition of the artwork, where the spatial dimension is foregrounded. This definition is demonstrated most notably in the 'Environment' installations of Allan Kaprow, and the land art of Walter de Maria, Jan Dibbets, and Nancy Holt, for example. Whereas an ecological description of work foregrounds the relational characteristics of the work. This is demonstrated, for example in the ecological systems work of Hans Haacke. It can be argued that art and artists concerned with an engagement with the earth expanded their focus during this period from the environmental to the ecological. That is, from the physical planet object to the relationships between things on the planet. This transition to a more expanded ecological model is apparent in the work of Robert Smithson, and his distributed sculpture, *Spiral Jetty*, (1970). This work did not fall into the site-specific 'thereness' of the earthwork category, as compared to the immensity of Michael Heizer's *Double Negative*, (1969), for example; as Smithson's

understanding and definition of the work were more complex due to his conception of ‘site’ and ‘non-site’.

The art roots of environmental art are multi-threaded including Minimalism, Conceptualism, Cybernetics, and the nascent Psychogeography of the Letterists. From a minimalist perspective, the influence was sculptural, with the work of Carl Andre, Tony Smith, Donald Judd and Robert Morris defining the era. Their work was to some degree a reaction to the Abstract Expressionism of the 1950’s, and instead revisited the formal, procedural and systemic concerns of the Constructivism and Suprematism discussed in Formal Systems. With several artists explicitly referencing their Russian forebears, such as Dan Flavin’s Monument to Vladimir Tatlin, and Donald Judd’s writings, such as, *Malevich: Independent, Form, Color Surface* in *Art in America*, in which he acknowledges his debt to Malevich in the balancing of colour with form. (Judd, 2016) Many of these artists worked with the primary earth materials of stone and iron and had a focus on the geometric constitution of the material, as opposed to the hand of the artist. As Robert Morris stated in an essay for *Artforum*, (1969), The sculptures were stripped right back formally and materially and, ‘away from illusion, allusion and metaphor’. (Rorimer, 2004, p. 21)

The main contributions of Environmental Systems to my practice and understanding of art can be summarised as follows

1. Time and space

    These works dealt directly with issues of time and space. The immense scale of the land art, such as *Spiral Jetty* (1970), for example, which confronts time due to the shear mass of material slowing the processes of erosion and entropy in the face of the natural forces of the earth. Thus, forcing the viewer to frame the work within a geological time, as opposed to a strictly culturally defined timeframe. Whereas, the performative work of the land artists, such as Hamish Fulton and Richard Long and the Performance Art of Bruce Nauman suggest time and space as something affective and to be experienced directly.

2. Energy in systems

    Energy within systems was understood on several levels within Environmental Systems, and they resonate with both the ecological systems discussed in Chapter 2, and the information systems discussed in Chapter 3. Firstly, there was the sense the environmental awareness of energy being expended and exploited in the use of fossil fuels. Secondly, energy exchange can be understood as the equivalent of information exchange. Thus, as the art object is de-materialised, so the focus of energy transfer shifts from the material stuff of heat exchanges to the conceptual stuff of information exchange. Thirdly, the focus on the flow of energy, (as either material or information), rather than a focus on the finished art object foregrounds the processes or relations at work and thus sees art as an ecological system that can be simulated and described in ecosystem and information terms.

3. Affective and performative use of the body in the world

    With the ‘de-materialisation of the art object’, described by Burnham, (1968) and Lippard, (1973) there was a shift by some systems influenced artists towards performance and a direct engagement with nature and space, as seen with the low, or ‘no-impact’ land art of Richard Long and Hamish Fulton, and the performance art of Bruce Nauman. These works literally and metaphorically mapped out the territory of ‘art as performance and experience in space’.

4. Entropy

    Another important aspect of Smithson's work is his interpretation of entropy, in which he understands the need to balance artworks in systemic terms to avoid entropic collapse.

5. Distribution

Distribution is also evident in the environmental systems, and this can be understood on two levels. Firstly, the work is expanded and distributed across the art objects and their processes and relations, as previously described by Ascott. This is also exemplified by Smithson's *Spiral Jetty*, (1970), as it can be understood as an expanded work encompassing a number of disparate elements. As Spiral Jetty, the artwork includes the earthwork, a film also entitled *Spiral Jetty* and numerous forms of documentation, writing and drawings and representations. Secondly, Environmental Systems work can be considered as distributed in the sense that they are informed by the concept of the ecosystem, which is a system of disparate components that exchange energy and information. Thus, such work is not only distributed across a range of objects and processes, but their relationships sustain the overall unity.

Social Systems

The final branch of Systems Art, defined here is 'Social Systems', and this covers work, which critically engaged with systems operating within society. As Lee notes there was the understanding of the 'system' in political terms and this referenced the 'political implications of a totalitarian or sinister nature, calling up a dark social machinery—a monolithic authority— against which the counterculture variously rallied'. (Lee, 2006, p. 62) Although there is a degree to which this work overlapped with the Environmental Systems work, the key distinction is that this work was reflecting on the social structures and forces in operation, and critiquing them. Thus, the work was more directly political and drew from the social sciences and structural descriptions of society.

Artists whose work were directly political and would fall into this category include Adrian Piper and Hans Haacke's institutional critique. Piper's work generally dealt with forms of racism and 'otherness'. An example of her work is the *Catalysis* series, (1970-1971) and it operated on an interesting performance/non-performance level as she created work in public, but as research not performance. (Rorimer, 2017, pp. 160-162) *Catalysis* was a series of conceptual performances in New York, which contravened social norms of public behaviour, and was documented through photographs

This work, along, with other social interventions, for example, Vito Acconci's *Following Piece*, (1969) were interesting for two reasons in relation to my own practice. Firstly, they employed methods of research and documentation, usually associated with the social sciences. For example, for *Following Piece*, Acconci randomly selected a person and followed them around until they entered a private space. He was interested in body language in public spaces, and drew directly from Kurt Lewin's, (1890-1947) *Field Theory*, documented in the *Principles of Topological Psychological* (1933), in which individual behaviour is understood in the context of its environment, or 'total field'. (Lewin, 2015) To carry out this 'research' he employed a strict set of rules of engagement in the project, as you would in social research and, he also rigorously documented the activity with notes and diagrams. This resonates with the 'ground truthing' processes employed in my own practice, mentioned in the context of my walking projects, (in Appendix 3).

The second interesting aspect of this work is the authentication process, which takes place with the documentation. Neither Piper nor Acconci announced that the work was

being made at the time of production, and to some degree, the truth of these activities has to be taken on trust; trust, that is, in the artist and their documentation. Related to this is the interesting slippage of time between the research activity and dissemination of 'evidence'. As Voorhies notes,

> 'One of the striking features of both Piper's Catalysis actions and Acconci's Following Piece is the way both performances partake equally of absolute immediacy and significant delay. The immediacy is in the unscripted interactions between the artist and an unsuspecting public. The delay is in the dissemination of knowledge about the work to an audience that has access to the activity only through the accounts and documentation the artist decides to provide'. (Voorhies, 2017, p. 218)

Extending this social research approach was Hans Haacke and his second phase of systems work, which could be described as 'institutional critique'. As noted, in his first phase of work, which could be described as cybernetic and environmental, he worked with biological and environmental processes, such as incubating chicks, growing grass, and managing ant colonies. Whereas his later 'institutional critique' work was more directly focused on the systems operating within art and wider society. A famous example of this is *Shapolsky, et.al. Manhattan Peal Estate Holdings, A Real Time Social System, as of May 1, 19711971 (no.44),* which was the direct appropriation of real-estate transactions, employed 'to unmask.. the inner machinations and inequalities of property.' (Salvo, 2005, p. 21)

The main contributions of Social Systems to my practice and understanding of art can be summarised as follows

1. Transdisciplinarity

Many of the artists operating within the Social Systems category have a transdisciplinary approach whereby they explicitly incorporate the ideas and methods of another discipline in the production of their work. The key thing from a contemporary art perspective is that these ideas and methods are both incorporated and translated, as the goals of the artwork are fundamentally different from the goals of the original discipline. This can be seen in the work resulting from Piper's performances and Acconci's walks. This is demonstrated in my understanding and application of Ecology, Geography and Information Science, and how these translate into an art, which is independent of these influencing disciplines.

2. Methodology and documentation

Documentation can operate as both record and aesthetic object, and reveals small conceptual and aesthetic differences through the repetition of data recording. This is starkly revealed in the work of Hanne Darboven, for example, and her work *Correspondences*, (1967-1975), in which she assembled a complex record of 1,150 documents that map her social and artistic networks during this period. I visited this exhibition at *Hamburger Bahnhof*, Berlin several times, over a four-month period, and it was impenetrable in terms of the content of the material, as it was in a 'raw data' state, and had not been translated into a more comprehensible form. Thus, the primary impact came from the physical installation, and the perceived scale of the operation in producing the work, rather than the meanings encapsulated in the texts and diagrams. This is an interesting appropriation of the research methods of social science, and such an approach is seen in much of the Social Systems work. Whereby it stops short of the analysis and presentation techniques normally associated with these methods, with the affect of retaining a distance between the viewer and the material, and forcing an 'open system' of interpretation.

3. Performance/non-performance

The work of some of these artists operates somewhere between performance and non-performance, as there is no audience at the time of the original production of the work. It is, however, important for the artist to carry out this activity, collect material and expend energy in the process. Although most of these works are ultimately driven by the material documentation there is still an underlying conceptual, psychological or affective imperative to carry out these actions. This is seen in the walks of Hamish Fulton, which are reduced to a single photograph, or the walks of Stanley Brouwn, which were reduced to short texts. This idea of 'performance/non-performance' is employed in my *System Walks*, in appendix 3.

4. Dual-time

There is an interesting dual time in operation in many of these works, as there is the time when the data collected, or the ‘performance/non-performance' takes place and the time in which the work is consumed by the artist or the viewer. This is demonstrated by Acconci's walks, for example, in which the walk takes place, and then the event or experience is represented to the final intended audience at a later date. This, dual-time is also a fundamental aspect of the performance-based works of Long, Fulton and Nauman mentioned under the Environmental category. This layering of experiential time is also directly employed in the *System Walks*, as there are multiple layers of time in operation within these works, in terms of data collection, data manipulation and data presentation

5. The psychic occupation of social space

Both Piper and Acconci’s walks recall the occupation and disruption of social space conducted by the Dadaists and the Psychogeography of Debord, and this is invoked in my own walking practice.

References for appendix 1

A Rational Aesthetic: The Systems Group and Associated Artists. (2008). Southampton England: Southampton City Art Gallery.

Bateson, G. (2000). *Steps to an Ecology of Mind.* University of Chicago Press.

Brown, P., Mason, C., Gere, C., & Lambert, N. (Eds.). (2009). *White Heat Cold Logic: British Computer Art 1960-1980*. Cambridge, Mass: MIT Press.

Debord, G. (2009). *Society of the Spectacle: Written by Guy Debord, 2009 Edition, Publisher: Soul Bay Press*. Soul Bay Press.

Glimcher, M. (2005). *Logical Conclusions - 40 Years of Rule-based Art*. New York City: Pace Wildenstein.

Harrison, C. (2002a). *Conceptual Art and Painting: Further Essays on Art and Language*. Cambridge, Mass: MIT Press.

Harrison, C. (2002b). *Essays on Art and Language* (2Rev Ed edition). Cambridge, Mass: MIT Press.

Judd, D. (2016). *Donald Judd: Complete Writings 1959-1975: Gallery Reviews · Book Reviews · Articles · Letters to the Editor · Reports · Statements · Complaints* (01 edition). Distributed Art Publishers.

Krauss, R. (2006). Two Moments from the Post-Medium Condition. *October*, *116*, 55–62. https://doi.org/10.1162/octo.2006.116.1.55

Latour, B. (1993). *We Have Never Been Modern*. (C. Porter, Trans.). Cambridge, Mass: Harvard University Press.

Lee, P. M. (2006). *Chronophobia: On Time in the Art of the 1960s*. Cambridge, Mass; London: MIT Press.

Lewin, K. (2015). *Principles of Topological Psychology*. (F. Heider, Trans.). Martino Fine Books.

McLuhan, M., & Fiore, Q. (2008). *The Medium is the Massage: An Inventory of Effects* (01 edition). London: Penguin Classics.

Morton, T. (2012). *Ecological Thought* (Reprint edition). Cambridge, Mass.; London: Harvard University Press.

Quaranta, D. (2013). *Beyond New Media Art*. Brescia: lulu.com.

Reichardt, J. (1971). *Cybernetics, Art, and Ideas*. Greenwich, Conn: Studio Vista.

Rorimer, A. (2004). *New Art in the 60s and 70s: Redefining Reality* (01 edition). London: Thames and Hudson Ltd.

Salvo, D. D. (Ed.). (2005). *Open Systems: Rethinking Art C.1970* (01 edition). London: Tate Publishing.

Shanken, E. A. (2015). *Systems*. Cambridge, Massachusetts: MIT Press.

Voorhies, J. (2017). *Beyond Objecthood: The Exhibition as a Critical Form Since 1968*. Cambridge, Massachusetts: MIT Press.

Whitehead, A. N. (1979). *Process and Reality*. (D. R. Griffin & D. W. Sherburne, Eds.) (2nd Revised edition edition). New York: Macmillan USA.

Appendix 2

The branches of Information

The branches of Information

As energy flows through an ecosystem, so information and meanings flow through an information system and art system. The early environmental artists such as Smithson understood the circulation of material energy in art systems and energy was embedded in the earth as fossil fuels. Fuller described this as

> 'stored "income wealth" generated by the sun's radiation and this fragile store was revealed and disturbed with the huge terraforming projects of Land Art' (Nisbet, 2014, p. 77).

Whilst, Robert Morris noted that cultural production required the storage and transfer of energy also, but the exchange was also informational.

> 'The means for production seems to be an accomplished fact. Control of energy and processing of information become the central cultural task.' (Robert Morris cited in Nisbet, 2014, p. 131)

Thus, energy can be understood as information exchange in the de-materialised or distributed art object and the focus shifts to the conceptual stuff of information exchange. This focus on the flow of energy, as either material or information, rather than a focus on the finished art object foregrounds the processes or relations at work and thus sees art as an ecological system that can be modelled in information flow terms. As Morris suggests,

> 'This reclamation of process refocuses art as an energy driving to change perception. . . . The attention given to both matter and its inseparableness from the process of change is not an emphasis on the phenomenon of means. What is revealed is that art itself is an activity of change, of disorientation and shift, of violent discontinuity and mutability.' (Robert Morris cited in Nisbet, 2014, p. 145)

There is, however, a fundamental difference between information and meaning, and meanings can change through circulation within these systems. The artist may or may not consciously know the intended meaning of the work, and each viewer will experience the work differently anyway. Thus, meanings are subject specific. The information, though, the things that flow into the art system, can be mapped from a systems perspective. The information entering and exiting an art system can take many forms, and this section is an attempt to map the categories of information. Marcia Bates, one of the critical thinkers in information science defined information as follows.

> 'Information is the pattern of organization of the matter of rocks, of the earth, of plants, of animal bodies or of brain matter. Information is also the pattern of organization of the energy of my speech as it moves the air, or of the earth as it moves in an earthquake. Indeed, the only thing in the universe that does not contain information is total entropy; that alone is pattern-free.'(2006, p. 1033)

The understanding of information from an ecological and evolutionary perspective can be traced back to Gregory Bateson, and his key works, *Steps to an Ecology of Mind*, (2000), and *Mind and Nature*, (1980). He famously defined Information as ‘a difference that makes a difference’ (Bateson, 2000, p. 453), and expanded on this to state,

> ‘perception operates only upon difference. All receipt of information is necessarily the receipt of news of difference, and all perception of difference is limited by threshold. Differences that are too slight or too slowly presented are not perceivable. They are not food for perception’. (1980, p. 29).

Bateson argued that from a scientific perspective the, ‘perception of difference’ is limited by consciously perceived thresholds of difference. Knowledge at any given moment will be a function of the thresholds of our available means of perception' (Bateson, 1980, p. 29). This definition limits Information to what can be consciously perceived, either through human observation or the calibrated tools of science and technology. The definition of information to that which is measurable is problematic when we move beyond science. Art, for example, accommodates the subconscious and affective, a space in which vastly more complex sensations of pattern can be experienced, if not wholly articulated. Indeed, one of the roles of art, which has remained, stable, if not always foregrounded, through Modernism, and Post-modernism and beyond is this subliminal power of perception, which has been variously defined concerning aesthetics and affectivity.

Bateson's definition also questions whether the information exists independently of its observability in the mode of the aphorism ‘If a tree falls in a forest and no one is around to hear it, does it make a sound?' Based on prior experience one could argue that the tree has properties such as mass, and there are forces that act upon the tree, such as gravity. Thus, if gravity causes the tree to fall, there will be a change in air pressure surrounding the tree. This pressure difference can be experienced as sound in the human ear or pressure change with a sensor. This difference in pressure value can be understood as information.

Information Categories

Marcia Bates has written extensively on information and her categorisation of information types has help structure my thinking in terms of information flow through the artwork. One particular paper, *Fundamental Forms of Information*, (2006 and 2016), has been invaluable in this research.

Bates argues for two vital pragmatic principles, which if accepted makes the definition of the term ‘Information' possible from an information science perspective. Firstly she argues that information exists, ‘in the structure, pattern, arrangement of matter and in the pattern of energy throughout the universe', and this is independent of the observer (Bates, 2016, p. 38). That is, the differences in air pressure generated from the falling tree are independent of the observer. This does not mean that the observer is in a position to observe things accurately, or that the process of observation is a neutral activity. From a second-order cybernetic perspective, the argument is that the person who engages with a system will inevitably alter it in some informational way. The physical presence of the person observing the falling tree, for example, adds to the disruption of the air pressure. Thus, the sounds the person experiences are a product of both the falling tree and their presence in the forest.

This relates to Bate’s second point regarding Information, and the circulation of matter and energy in the world. Bates argues that information is both external to the body, such as the air pressure, but also internal to the body in the affective responses of the mind and body as it experiences the world. As Bates describes how this information is constructed,

> ‘by living beings interacting with the world, and stored in their sensory, nervous, and biochemical systems. Thus our subjectively constructed understanding of the world, stored in our minds and feelings, can be viewed from the exterior as well, as one more body of information with a particular pattern of organization.’ (2016, p. 38)

Thus Bates argues that information can be understood as an, ‘objectively existing phenomenon in the universe’, (2016, p. 38), in much the same way that most scientists and the philosopher Graham Harman would claim the independent existence of objects, and both the objects and information about them are to some degree withdrawn and independent of our senses (Harman, 2011). While her second points highlight this withdrawal as the reception of the information is necessarily particular and subjective and defined by the social and environmental conditions of the observer.

These different layers of information complicate the relationship between the external ‘out there' information and the internal experienced sensory information. We can think of information concerning first, second, or third-hand experience, as an object, a rock, for example, can be experienced at different levels of removal. A first-hand experience of holding the rock in my hand gives me the sensation of weight, temperature and texture. This is subjective descriptive information; personal to my experience, although others may relate to the description I give. Whereas the second-hand experience uses tools to quantify the rock using scales and geological knowledge and this translates the information based on the observable differences, as described by Bateson, ‘a difference that makes a difference’. The rock could be a piece of Gabbro, for example, and weigh 1.2 kilograms. Finally, the third-hand experience of the rock is when the primary experience of the rock is solely the information, and the relationship is broken between the information and the subject. Thus, an indexical list of abstracted locations, rock types and weights, is a disaggregation of the research from results and could be misunderstood without the original context. This is a simple example to demonstrate the principle, but when this is scaled up to a more complex empirical project, then the scope for the misuse of information is increased considerably. Thus, these layers of information and experience can be considered as a series of concentric circles moving further away from the original subject at its source, and first-hand experience. See figure 1

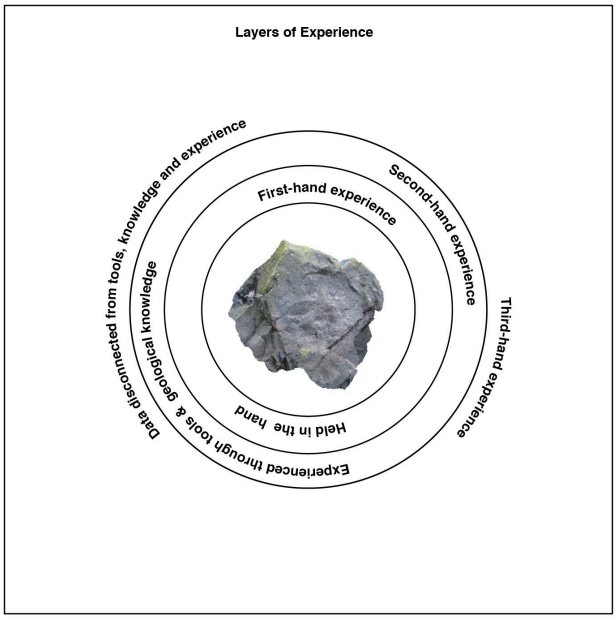


Figure 1

Concentric circles of information & experience

Bates has attempted to deal with the different qualities or kinds of information by developing a taxonomy of information. There is, though, as noted, a fundamental difference between information and meaning, and the mapping of information within an artwork in this way only demonstrates the space between these two. As Bates notes, 'Living beings can assign meaning to information, but patterns of organization of matter and energy are not inherently meaningful' (Bates, 2006, p. 1041). It is, therefore the viewer, and the artist, (as a viewer of the work), who experience the work and information that assign the meaning, as the new material co-mingles with their wider experiences. Thus, beyond the categories and types of information, there needs to be a consideration of how this information flows through an artwork.

Bates defined four categories of information, based on the earlier work of Goonatilake's, *The Evolution of Information: Lineages in Gene, Culture and Artefact* (Goonatilake, 1991). These are *Genetic information, Neural-cultural information* and *Experienced information*. These are summarised here, (figure 2), as they are a useful way of visualising what information is circulating within a distributed artwork.

Information Categories Goonatilake, (1991)	Information types Bates, (2006)
Genetic	Genetic
Neural-cultural	Experienced
	Enacted
	Expressed
Exosomatic	Embedded
	Recorded
Residual	Trace

Figure 2

Categories of information

Genetic information

From a biological perspective, the Genotype is part of the DNA sequence, which determines a specific characteristic of that cell or organism, whereas the Phenotype is the genetically and environmentally determined embodiment of a genotype (Dawkins, 2016). The concepts of Genetic information, Genotypes and Phenotypes map neatly to the rule-based art. Such work is created from the application of rules, and through their application, the underlying structure and patterns are revealed. I would argue that these works can, in informational terms, be understood as containing 'Genetic information', (Bates, 2006), or Rule-based Information, and the original idea is derived from Genetics and the concepts of the Genotype and Phenotype. From a biological perspective, the Genotype is part of the DNA sequence, which determines a specific characteristic of that cell or organism, whereas the Phenotype is the genetically and environmentally determined embodiment of a genotype. For example, the colour and distribution of patterns on a butterfly's wing is a product of the underlying code, the Genotype combined with environmental factors to produce examples of the wing, the Phenotypes. Thus the perceived patterns in the wing derive from the Genotype code, but these vary due to environmental factors, which can be described as 'Phenotype plasticity', (Beldade & Brakefield, 2002, p. 446)

Neural-cultural information

The second information category of information, the Neural-cultural information is described by Goonatilake as the feedback relationship between the neural system, of the animal or human and its environment, which influences the behaviour of both. (Goonatilake, 1991) These three forms of Neural-cultural (Experienced, Enacted and Expressed), information could be described as affective information.

Experienced Information

The first category of experienced information most clearly exhibits the sensation of affect, and Bates gives an example to illustrate this. Bates suggested this is a form of 'embodied information', which results from neural activity and gives the following example.

> 'A stubbed toe, which produces another round of neuronal activity, is not felt as neurons firing by the person experiencing the incident; rather, that person feels the pain of a stubbed toe — and in the toe — not in the brain.' (Bates, 2006, p. 1038)

Thus, from an art perspective, it is the direct bodily responses involved in the production or reception of work.

Enacted information

According to Bates's information categories, 'enacted information' describes the pattern of organisation of actions as we interact with our environment, as we utilise our capabilities and experience. Bates notes that we all experience our own lives mentally, but when we act in the world, the combination of, ‘our genetically endowed talents and life knowledge become visible to the external world', and this is enacted information (Bates, 2006, p. 1038). Thus, we can enact information, through cooking, eating, drawing and painting, and these are a synthesis of our effort, learning and genetic predispositions.

Thus, from an art perspective, it is the skills we have developed to perform certain tasks that have meaning within the social art context, such as drawing, singing, or bodily movement.

Expressed information

Expressed information encompasses spoken and written language, and physical gestures and Bates summarised it as follows, ‘the pattern of organization of communicatory scents, calls, gestures, and ultimately, human spoken language used to communicate among members of a species and between species' (Bates, 2006, p. 1036). Thus the function of Expressed information is intentional communication, other than the ‘spontaneous cry of pain or fear' (Bates, 2006, p. 1039).

Thus, in art terms, whilst an ability to draw can be seen as 'enacted information', the more complex language the artist develops through their work can be understood as expressed information. This helps distinguish between very conceptually driven work, which is stripped of decoration, such as the work of Art & Language, and the work of Cy Twombly, for example, who employed a very complex visual abstract language that was personal to his practice. Art & Language would employ the English language in a very direct way to discuss art theory, philosophical ideas and critique the art system. This was a shared language which all english speakers would understand, even if they did not understand the underlying ideas. Whereas the ideas contained in Cy Twombly's visual language were more challenging to understand as he created a very complex and distributed system of ideas, mark-making and allusion to other work, which was

particular to his practice. Thus, to understand his language system, one would have to understand the underlying distribution of marks, symbols and texts he employed.

Exosomatic information

The third Information category defined by Goonatilake and refined by Bates is Exosomatic information, which is information stored in forms external to the body. Bates distinguishes between two types of Exosomatic information types Embedded and Recorded Information, (2016, pp. 50–52).

Embedded Information

Bates defines embedded information as the 'pattern of organization of the enduring effects of the presence of animals on the earth; may be incidental, as a path through the woods, or deliberate, as a fashioned utensil or tool' (Bates, 2006, p. 1036). Thus, the beaver's dam can be considered as an example of incidental embedded information. In an email discussion with Bates, she expanded upon this concept suggesting that if information, 'is the pattern of organization of matter and energy, then embedded information is the pattern or organization of matter and energy that is left' (2017). She also drew a comparison with Dawkins concept of the 'extended phenotype', and the idea that the marks we leave in the world are an extension of us, (Dawkins, 2016). This also alludes to the dialectical nature of ecosystems, and as Morton notes, 'environments coevolve with organisms' (Morton, 2012, p. 51). Thus, an art practice, seen in this light, is extended through the spaces and materials that are transformed, recycled and discarded. Likewise, the lives and ideas transformed through an artwork, idea or intervention can be seen as an extension of the practice and evidence of the artist's agency.

Recorded Information

Bates describes Recorded Information as 'communicatory or memorial information preserved in a durable medium' (Bates, 2006, p. 1039). Here Bates discussion focuses on the conscious use of symbols to communicate information to others, with language being the primary example. Symbolism and indexical systems of communication extend beyond language, particularly in science and art where other characteristics such as colour, texture, weight, proportion and scale are visualised with non-linguistic systems.

Residual information

The final Information category of Residual Information describes the Trace Information, which Bates describes as information which is 'incidental to living processes or which remains after living processes are finished with it' (Bates, 2006, p. 1036). Bates expanded on this as follows,

> 'Trace information is that information that is degrading from being represented information (encoded or embodied) into being natural information only (neither encoded or embodied). Trace information includes the no-longer-used wasps' nest, waste heaps, carrion, disintegrating ancient scrolls, and so on.' (Bates, 2006, p. 1040)

In conclusion to this summary, I have simplified and revised the naming of the categories of information, (of Goonatilake, (1991) and Bates, (2006)) as terms to be employed within an art system. Thus, although the intended or unintended meanings of the artists cannot necessarily be known, the information flow through a work can be mapped using these categories.

Information Categories Goonatilake, (1991)	Information types Bates, (2006)	Revised Art information categories
Genetic	Genetic	Rule-based information
Neural-cultural	Experienced	Affective information
	Enacted	Enacted information
	Expressed	Expressed information
Exosomatic	Embedded	Functional information
	Recorded	Recorded information
Residual	Trace	Residual information

Figure 3

Categories of information within the artwork

References for Appendix 2

Bates, M. J. (2006). Fundamental Forms of Information: Research Articles. *J. Am. Soc. Inf. Sci. Technol.*, *57*(8), 1033–1045. https://doi.org/10.1002/asi.v57:8

Bates, M. J. (2016). *Information and the Information Professions: Selected Works of Marcia J. Bates, Vol. I*. Berkeley, Ca: Ketchhikan Press.

Bateson, G. (1980). *Mind and Nature* (New edition edition). London: HarperCollins Distribution Services.

Bateson, G. (2000). *Steps to an Ecology of Mind.* University of Chicago Press.

Beldade, P., & Brakefield, P. M. (2002). The genetics and evo-devo of butterfly wing patterns. *Nat Rev Genet*, *3*(6), 442–452. https://doi.org/10.1038/nrg818

Dawkins, R. (2016). *The Extended Phenotype: The Long Reach of the Gene* (Reprint edition). Oxford, United Kingdom: OUP Oxford.

Goonatilake, S. (1991). *Evolution of Information: Lineages in Gene, Culture and Artefact*. London ; New York: Cengage Learning EMEA.

Harman, G. (2011). *The Quadruple Object* (Reprint edition). Winchester, U.K.: Zero Books.

Morton, T. (2012). *Ecological Thought* (Reprint edition). Cambridge, Mass.; London: Harvard University Press.

Nisbet, J. (2014). *Ecologies, Environments, and Energy Systems in Art of the 1960s and 1970s*. Cambridge, Massachusetts: MIT Press.

Appendix 3

The Withdrawn Fold

The Withdrawn Fold

The ‘Withdrawn Fold’, has been included as an appendix, to support and illustrate the observations and arguments made in the thesis. It contains examples of my art practice produced as part of this research, and includes explicitly systems-based work, painting, constructed photographs and walking projects.

There are three forms of systems-based work presented in the fold. Firstly, there is ‘Rule-based Systems’, in which rules are employed in the production of the work. Most of my painting production falls into this category, as I create rules in the creation of work, and I investigate the limits and emergent qualities of these processes. These works draw from my experience of applying and deviating from rule-based procedures to satellite images, so that new patterns can emerge from within the pixels. It also draws inspiration from systems painters who balanced conceptuality with aesthetic investigation through the application of rules. Secondly, works, which are structurally more complex, can be understood as ‘Ecosystems’, and the concepts of the ‘ecosystem’ and ‘information flow’, are employed to functionally describe them. Finally, there are works, which operate as ecosystems, in that they are distributed across a range of materials and processes, but their underlying structure cannot be explained in morphological terms. These more ambiguous works can be considered as ‘disruptive’ systems, and require the flexibility that the concept of the Distributed Ecosystem affords.

Rule-based Systems

Rule-based Systems

Introduction

Most of my Rule-based work begins with painting as an approach as I understand much of my work in painterly terms. This understanding also stems from working with satellite images, as these were manipulated through the overlaying and erasing layers of colour. That is, a combination of intuition, dexterity and rules were required to reveal the information within these images and to unfold their meaning. Thus, the processes employed were similar to systems-based painting, and I see the employment of these experiences within a painting context, as part of the expansion of painting as a methodology.

Painting has expanded from its position of medium specifity to a method of investigating abstract ideas. For example, through the layering and removal of material, conceptually expanding and compressing time and space, unfolding ideas and narratives, and negotiating the dialectical relationship between our inner model of the world and its simulation in diagrammatic form. Jonathan Harris captures this expansion by suggesting, 'Painting... has become the name for an exploration and extension of these implicated conceptual and physical resources' (Harris, 2003, p.238). Whilst, Petersen reflects that, 'when contemporary painting is compared to modernist painting it becomes obvious that the range of content has also been expanded. Painting has indeed become an outward-looking forum'. (Petersen, 2010, p. 123)

Painting in territory terms went through a period of contraction during the 1960s, due to the expansion of conceptual art, and painting's medium specifity at a time of media expansion in other areas. Fluxus artist Dick Higgins and his concept of InterMedia and Stan Vanderbeek's *Expanded Cinema*, for example, more fully occupied the unfolding of space and time. Gustavo Fares highlights this shifting status of painting and the operation of the work in terms of message in the following comment.

> 'Narrative, for instance, has been taken over by the video, while the importance of "seeing" and of "being there" seems to have been passed on to the realm of the installation and performance art, where the actual space is an important component of the piece. The "message," if ever was such, has been emptied from the painted piece and taken over by the critics, or the artists themselves, as a verbal activity, parallel and not necessarily related to the art works being produced.' (Fares, 2004, p.484)

However, there was a counterpoint to these challenges and the conceptually driven painters of the period were finding new ways of expanding painting in terms of the contemporary conditions. Donald Judd, for example, moved to three-dimensional objects, but he retained a painterly focus on colour. Whereas, Rauschenberg experimented continuously with the boundaries of painting, through his Assemblages, Combines, and multi-media projects, to creating works that left the surface of the canvas. He introduced three-dimensional objects into the paintings, including moving elements, such as clocks in *Third Time Painting*, (1961), and mirrors in *Charlene*, (1954). These expansions involved the viewer in the work, and thus changed painting from an independent object to a contingent object. (Joseph, 2007)

As painting has expanded in its terms, so its engagements with ideas have expanded. This is particularly the case with abstraction, which has seen several waves of renewal since the mid-1980s, with artists expanding the reach of abstraction into other forms of abstraction, such as scientific information. Hal Foster noted the expansion of abstraction with artists such as Jack Goldstein and the 'technological modes of control of nature', James Welling and the abstraction of scientific images, and the cybernetics of Ashley Bickerton. (Myers, 2011, pp. 51–52)

The term 'Expanded Painting' did not, though, emerge as a widely used category until the new millennium. Douglas Fogle had used the term 'expanded concept of the painterly', (Fogle, 2001) to suggest an expansion of painting, and Fares reconfigured Kraus's use of the semiotic square to discuss, *Painting in the Expanded Field*, (2004). Fares reworked the square to understand painting with the additional terms of three-dimensionality and movement. (Fares, 2004, pp. 481–482) As with Kraus's original concept of *Expanded Sculpture*, (1979), towards other media painting has not only expanded its range of materials, but it has also expanded to be seen as a methodological approach rather than a choice of materials. Paco Barragán marked 2006 and the painter Tomma Abts winning the Turner Prize as a possible turning point for a further expansion of painting. The following year he co-curated the show, *The Expanded Painting Show*, with Nina Arias at MASH Miami, and this marked the establishment of the term within the Contemporary art market discourse.

In addition to the establishment of the term as part of the wider discourse the technological advances during the preceding decade had given a generation of art

students access to new materials and processes, and this was starting to affect methodologies. This is noted in the following statement from Barragán.

> ‘The digital syntax calls into question the pictorial construction of a painting using internet, mass media, as well as digital video, photo cameras, game consoles and programs like Photoshop. These and other technologies, together with a more interdisciplinary artistic approach where sculpture, installation, and photography come into play, allow the artist new means to find, capture, sample and construct images. This means a whole new way of creating and looking at a painting’ (Barragán, 2007).

However, the expansion of painting is more than these technological developments. The shifts are philosophical and conceptual, as Barragán notes, ‘the painter ..assumes an interdisciplinary practice that questions every logic or modernist purity of the medium, which on its turn is no more than a true reflection of the "information society" we live in’ (Barragán, 2007). This observation of the informational context of painting is very important in my practice, and this extends the concept beyond the critical use of media and technology to the direct manipulation of information as a material. Specifically, I am interested in the way that information is collected as input material for information systems and how, in its raw state is abstracted information. I am also interested in spatial analysis issues that draw from my experience in mapping, and ecology, such as spatial patterns, scale and boundaries issues.

There are three key forms of abstract information present in my work that draw directly from the ecology and information work. Firstly, there is aspatial information in which the painting or information is reduced to an index to refer to something else, and the spatial aspect of the abstracted subject is lost. Secondly, I am interested in the spatial information in which the boundary of phenomena is consciously delineated vector shapes and the temporal information is lost. Thirdly, I am interested in the dialectical relationship between the spatial and temporal information contained with information and how this is expanded and condensed into a single painting through the process of abstraction.

An issue in spatial mapping is the digital representation of objects and phenomena in space and time, and whether values or characteristics are attributed to a line or point in space and time, or whether values are attributed to an object. The difference between aspatial information and spatial information can be represented with two paintings to illustrate this point. For example, the digital paintings ‘The three brethren’, 2014 and 2015, (Figure 1) consist of grids of colour values.

These works were created from sampling colour values along a walk to the large Cairns known as ‘The three brethren’. I have made this walk over many years and created a painting each time. The colours recorded in each work are an abstract record of not only of how the colours have change seasonally, and over time, but how these changes have been mediated by my subjective selection of these colours. Thus, they are an abstraction of an abstraction in the sense that they are record of colour selection that relates to both the original experience of the walk and the secondary experience of selection.

These works can be understood in indexical terms as the colours have a correlation with something real, which has been experienced in the world. These works can also be considered as a ‘simulation’ on two levels. Firstly, the painting operates as a model or descriptive system of what was observed and selected in the real world. Secondly, it alludes to the structure of colour field paintings and satellite images. In terms of the grid structure of solid colours these works have a direct antecedent in the works of Gerhard Richter’s colour field paintings, such as ‘192 Farben’, (1996) or James Hugonin’s Binary Rhythm series, (2010-2015), which consist of grids and solid coloured squares. These colour field paintings are also analogous to the structure of a digital image, and specifically a satellite image with rows and columns of pixels of colour.

In ‘The three brethren, 2014’, for example, the world or the substrate is divided into equally sized squares and these can be read as a uniform abstraction of space. Space can therefore be read in x and y coordinate terms, starting at the lower left square, or coordinate 0,0. These paintings, though, are more complex than a simple scanning, pixelating and abstracting of the surface of the subject, as these abstract squares also contain the unseen fourth dimension of time, as the progression through the coordinates also represents a progression through time. Thus, these paintings, like all paintings abstract the dimension of time, so that they can be contained in a singular ‘out of time’ object.

The second type of work, documented in several series of works, (figures 2 and 3), operate in a different way as the colour value and the shapes of solid areas of colour operate together to both represent the indexical value and the defined areas. These shapes are analogous to the vector shapes on a map where the line diagrammatically distinguishes the boundary of an object, such as a lake. Thus, they operate more like

an iconic or symbolic image, as the shapes suggest the image contains more than the indexical value, but denotes the boundary of an object. In ‘iconic’ terms the paintings suggest, either intentionally or unintentionally visual forms, such as a lake. Likewise, they can be read symbolically as representing balance, in terms of both colour and form. As with the colour field paintings the construction of these paintings is more ambiguous than the construction of a vector-based map. With a map the solid shapes are consciously designed and based on the contiguity of the data values. For example, all the contiguous water values create a lake. Whereas the paintings are created from the layering of abstract shapes and the final composition is an emergent property of this process.

A painting contracts time in the same way that a map fixes time and space. However, I am also interested in the incorporation of the fourth dimension of time, as it creates a temporal space in which new configurations can be considered in a sequence. These works do not operate as films or narratives; rather each painting or frame is a possible model for a completed work. This can be seen in the series of paintings in figure 4 in which three-dimensional forms are unfolded and fractured.

Likewise, the paintings also operate within an expanded form of space and time if they belong to a wider dynamic ecosystem, as this allows for an infinity of expansion and reconfiguration of materials as the system develops and occupies greater territory. Thus, whilst an individual painting or photograph fixes time they are part of a wider complex ecosystem that operates within and without time.

Thus, much of my art practice can be understood as a form of expanded painting, which is created through the application of rules. These paintings are created through the application of paint on a two and three-dimensional substrates, (see figure 5), and they can be created digitally as still and moving images. I do not make the distinction between painting with physical liquids and digital painting, which are constructed from manipulating pixel values. The same underlying generative rules are applied and the same affective employment of the hand is employed either to hold a brush or hold a digital pen. Whilst the works produced can be understood in terms of the system concepts of feedback, chaos, entropy, noise and emergence.

Robert Morris noted the strategy of employing rules stating, ‘artists have increasingly sought to remove the arbitrary from working by finding a system according to which they could work,’ (Morris, 1995, p. 95) and this captures the essence of my approach

to the use of rules at the production stage. There are two aspects of the rule-based work that figure directly in my practice. Firstly, there is the idea of the employment of systems in the production of work, as this carries some of the decision-making; this was demonstrated by artists such as Sol LeWitt and his *Sentences on Conceptual Art*, (1969).

Secondly, there is the idea of control within systems, and the system is mediating the chaotic and entropic tendencies in the work. That is, the system is a device to structure the intuitive and affective actions of the artist. Historically this was not demonstrated by the formal systems painters, such as LeWitt or Kenneth Noland, but by the earlier Abstract Expressionists, such as Jackson Pollack and Willem de Kooning. Writing at the end of the 1960s the critic David Sylvester reflected on the difference of approach between the Abstract Expressionists and conceptually mediated Systems painters, noting

> 'Some artists like to think they are working in the dark, others that they are firmly in control. The preference seems almost more a matter of generation than of individual temperament. Most of the artists whose styles were formed in the 1940s subscribed to the idea that making art meant feeling one's way through unknown territory... The typical art of the Sixties ... has an air of certainty and decision. The artist, like a good executive, makes up his mind what he will do and does it, or gets it done to his specifications'. (Sylvester cited in Galenson, 2002, p. 112)

Thus, it can be argued that both the conceptually rule-based artists of the 1960s and the earlier Abstract Expressionists of the 1950s were employing forms of systems in the production of their work. The difference is that the conceptual artists employed ideas at a conscious level to unfold an idea, whereas the Abstract Expressionists employed systems to allow a more direct affective experience of the material. Thus, they applied rules as a structure to allow freedom. The distinction between the two is captured in this statement from Robert Morris.

> 'The entire stance of a priori systems according to which subsequent physical making followed or was made manifest are Idealist-oriented systems that run from Duchamp down through the logical systems of Johns and Stella to the totally physically paralyzed conclusions of Conceptual art. This has been one thread of how the systematic has been enlisted to remove the arbitrary from art activity. Another thread of system-seeking art making, distinct enough to be called a form of making, has been built on a more phenomenological basis where order is not sought in a priori systems of mental logic, but in the "tendencies" inherent in a materials/process interaction. Pollock was the first to

> make a full and deliberate confrontation with what was systematic in such an interaction.' (Morris, 1995, p. 77)

As Morris notes Pollock is not dealing with randomness and chaos, but with a system of control so that he can focus on the properties of the materials. There is a level of chance within the paintings, which is based on the degree to which he can control the morphological processes of paint viscosity as it is mediated by gravity and movement. These works were designed so that the artist relinquished some compositional control of the works and created a framework to allow 'affective feedback'. I am interested in the intersection between these two applications of structure in the production of work, as they have been historically divided, but from a systems perspective share an underlying systemic philosophy.

Thus, it can be stated that through the application of rules the underlying structure and patterns are revealed. I would argue that these works can, in informational terms be understood as containing 'Genetic information', (Bates, 2006), or Rule-based Information as the underlying genetic code is the set of rules from which the work is constructed. Whilst the artworks can be understood as the phenotypes generated from the rules, and variations from these rules can be attributed to environmental factors, or flexibility in rule application or 'Phenotype plasticity'.

Another aspect of the rule-based works is that they are made in series. This relates to the rules and patterns emerging over time and to the idea of the wider project or system. This also returns us to Bateson's (and Deleuze's), idea that how we experience difference is how we understand and calibrate the world. As Bateson states, 'perception operates only upon difference.' (Bateson, 1980, p. 29) The audience cannot directly see the underlying rules and structure of these works, as they may be complex, (and due to their plasticity held deep within the artist), but they can be felt, and what they are feeling is the withdrawn system, the underlying order that describes the work and hold them together.

Studio work

Figure 1

‘The three brethren’, 2014 & 2015

Ink on paper

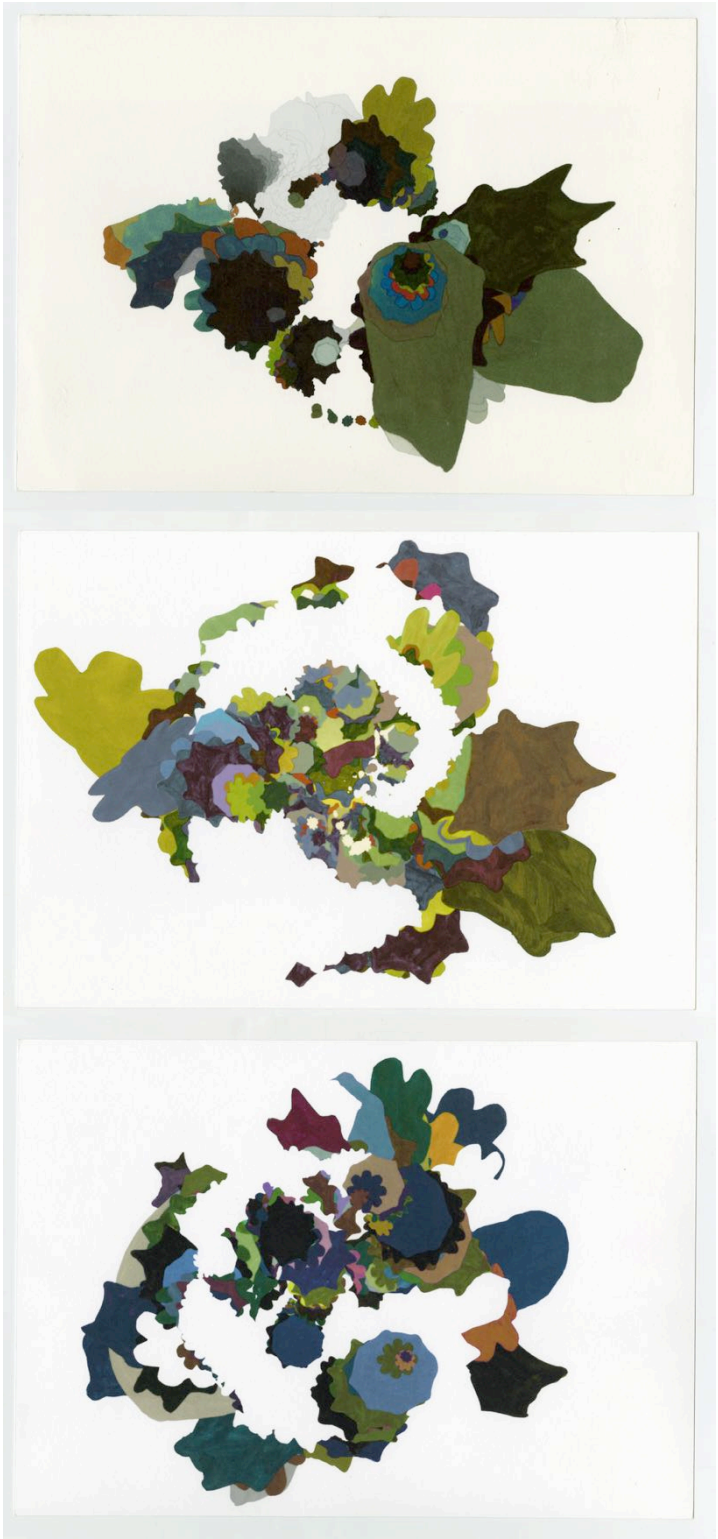


Figure 2

Airigh-Dirishaig, 2011-2013

Ink on paper

Figure 3

‘Untitled’, rule-based paintings, (2012-2014)

Ink on paper

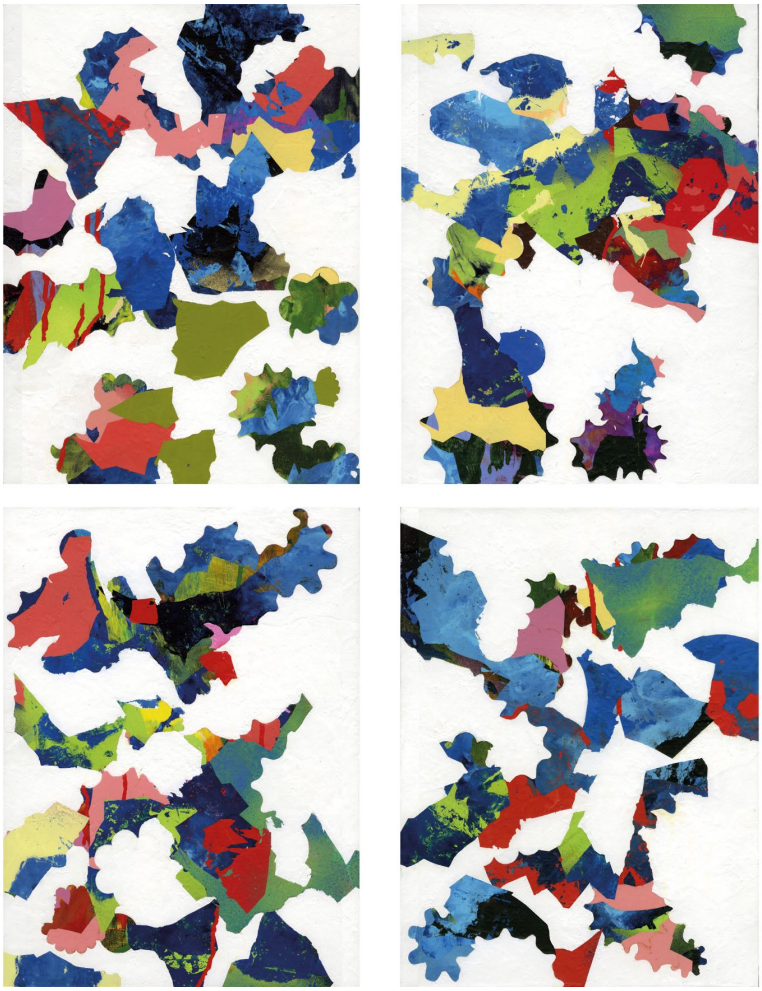


Figure 4

‘Untitled’, Four-panel painting 2014

Acrylic on wood

Figure 5

‘Untitled’, 2014

Acrylic on wood

Figure 6

‘Untitled’, Four-panel painting, 2014

Acrylic on wood

Figure 7

‘Untitled’, Three-panel painting, 2013

Acrylic on wood

Feedback in painting

Feedback operates on different levels within my work. In terms of the rule-based work it is not only in the rules of production, but the experience of production. This can be effort required to climb a mountain to collect the colours or the resistance of the brush on the canvas, or the turning of wood on a lathe. The examples of feedback given here are narrowly focused on the construction process within the paintings. Thus, the aim of mapping the feedback relationships here is limited and is not an attempt to pinpoint where the art experience resides within a particular piece of work. Rather it is a method to map the morphological and cascading flows of decisions and materials to produce a particular piece of work. There are four types of feedback, and these are illustrated with work, which employ them in their production. They are Direct Feedback, Looped feedback, Positive feedback, Negative feedback and Positive and Negative feedback.

Direct Feedback

The simplest form of feedback is 'Direct Feedback', and this can be demonstrated with the colour sampling work created, as part of 'Avec Nadja', (2017-2018), which is discussed in more detail under Ecosystems. As part of this project I sampled colours from objects I interacted with in Paris using a very accurate colour-sensing device. The simple feedback relationship was as follows. I observed the available colours in the world, and I perceive these subjectively, filtered through my sight, and mind's eye and I made a selection. These colours are stored on the device numerically, and then later I can download these and constructed a colour system. I do not, though, see the palette develop incrementally whilst on the walk, and so the choices are not influenced directly by the previous samples. See flow diagram, figure 8.

Looped feedback

The second simplest form of feedback is where information or material goes through a form of transformation. The example here from the System Walk project 'Rosa-Luxemburg-Platz', (2012) demonstrates this process. In terms of feedback the colour is observed and then it is sampled, and placed at the point of sampling on the image, and the revised composition is observed which may influence the selection of the next colour, as both colour and composition need to be taken into consideration in the following selection. See flow diagram, figure 9.

Positive feedback

The positive feedback in terms of my painting practice demonstrates an increase in complexity from the looped feedback work. As, in addition to the echo and repeat effect of the looping, there are changes in the parameters of colour, and shape in response to the evolving compositions. This can be demonstrated with the four-panel painting 'Untitled' Four-panel painting, 2014, (figure 6), in which the work evolved in response to this positive feedback cycle. These paintings were created by layering a single painted motif, one at a time and the composition evolved in the response to this positive feedback cycle. See flow diagram, figure 10.

Negative feedback

A more complex process still follows the positive feedback of adding material and reflecting on the evolving compositions until such time that negative feedback is used to start to negate and remove parts of the painting. This is demonstrated in the three-panel painting 'Untitled' Three-panel painting, 2013, (figure 7). These paintings were created by adding a single solid painted motif at a time and the composition evolved as a result of the processes of erasure and over-painting. Additionally, the morphological process of gravity was employed as an uncontrollable force to act upon the composition. See flow diagram, figure 11.

Positive and Negative feedback

The most complex process of feedback demonstrated here is where there is both positive and negative feedback within a single painting. This is demonstrated in the series of paintings, ''Untitled' Four-panel painting, 2014, (figure 4), in which the paintings have gone through phases of addition and erasure. These paintings are structurally more complex than some of the other paintings as they are not constructed from solid painted motifs, but oscillate between order and disorder. So that during a positive phase the painting will be constructed in a very free way with addition of paint that is not constrained by the motif boundaries, and the painting starts to exhibit a level of disorder. And the order is returned to the paintings in terms of balance, composition and shape through the erasure of material to form new structures that echo the underlying motifs as both positive and negative spaces. See flow diagram, figure 12.

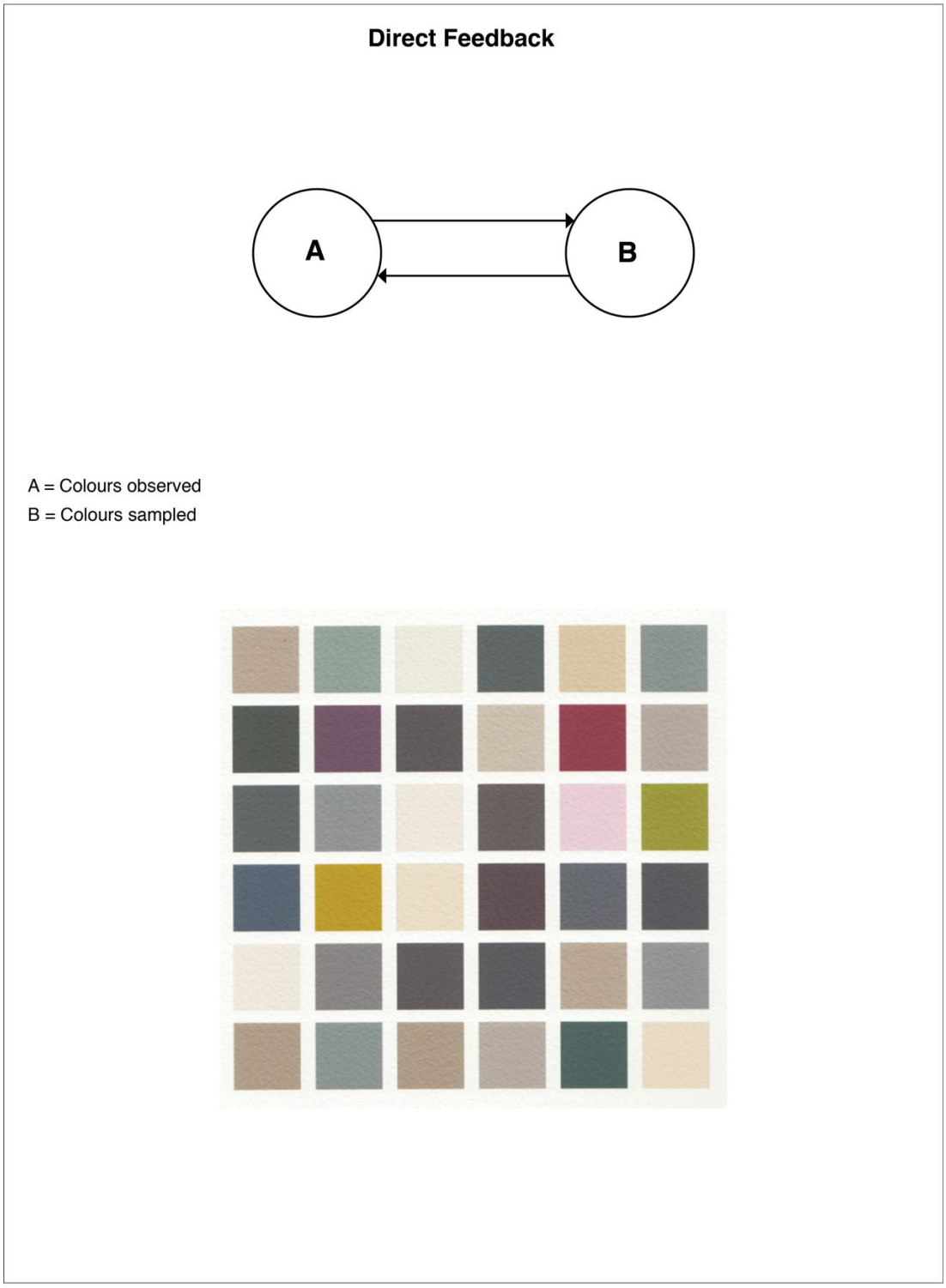


Figure 8

Direct Feedback

The feedback relationship is very direct, as a colour is observed and then it is sampled, without any transformation of material or information.

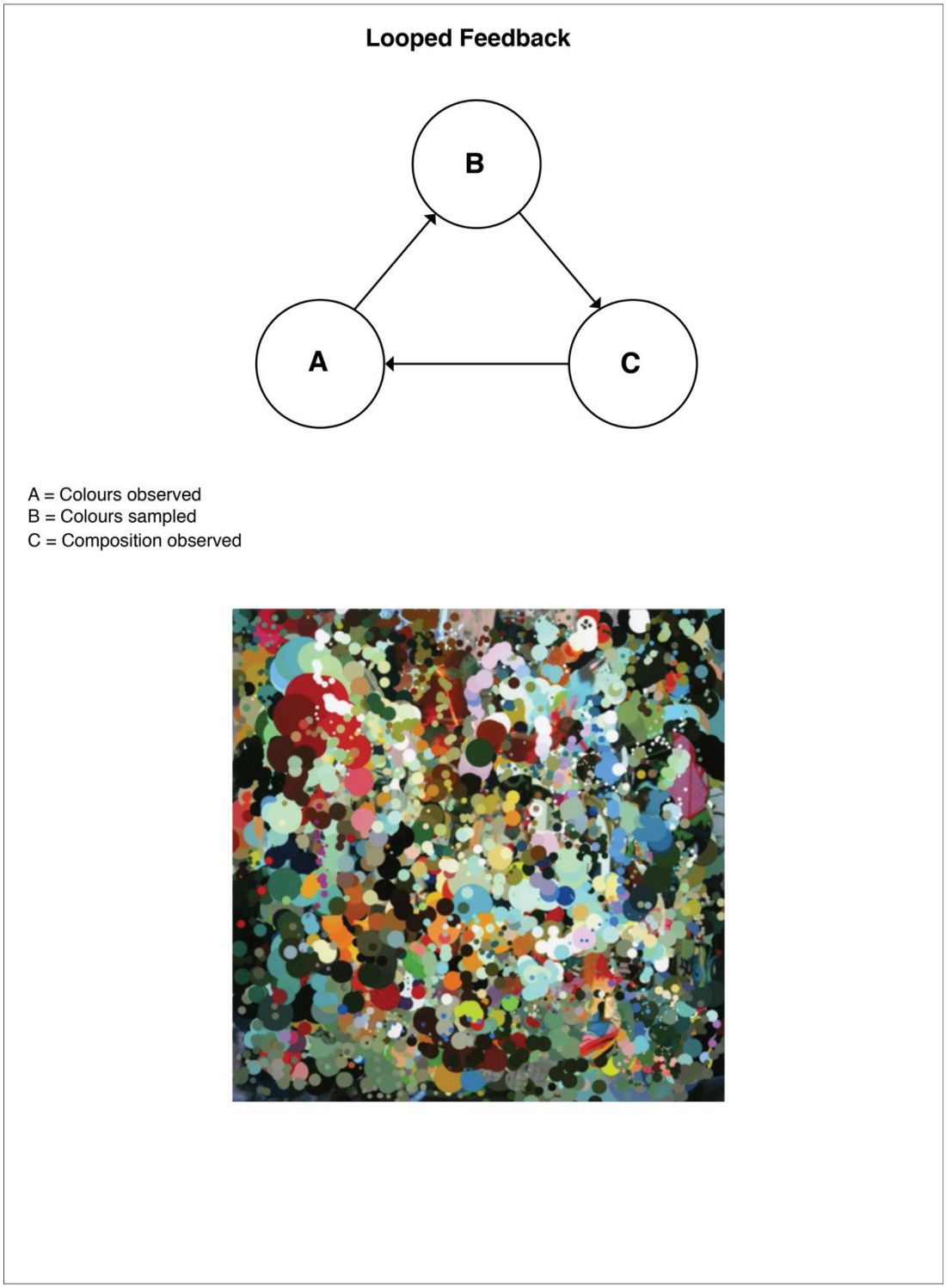
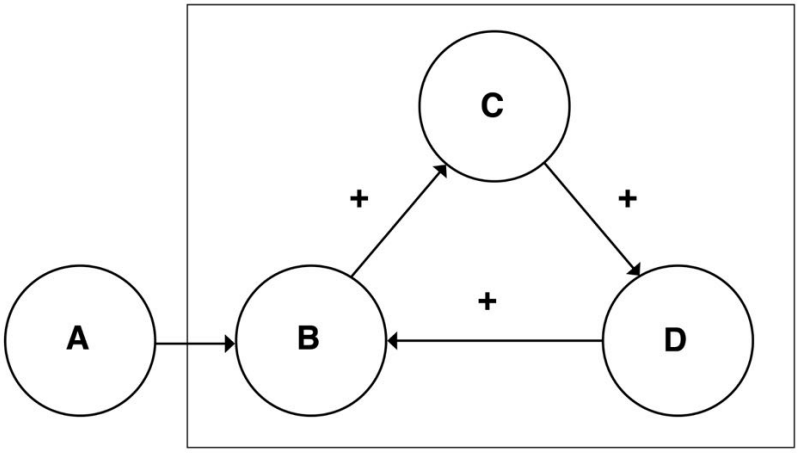


Figure 9

Looped Feedback

These digital paintings are produced through real-time colour sampling of the walk photographs. The colour is observed, (A), then Sampled, (B), and then the composition is observed, (C). This process is then repeated for the duration of the walk.

Positive Feedback



A = Material input
B = Colour mixed
C = Colours, shape and texture applied
D = Composition observed

Figure 10

Positive Feedback

Material is input into the system, (A), where the colours are mixed, (B), before they are translated into shapes and texture. The effect of the addition is then observed, (D), and this information is fed back to influence the next layer of the painting.

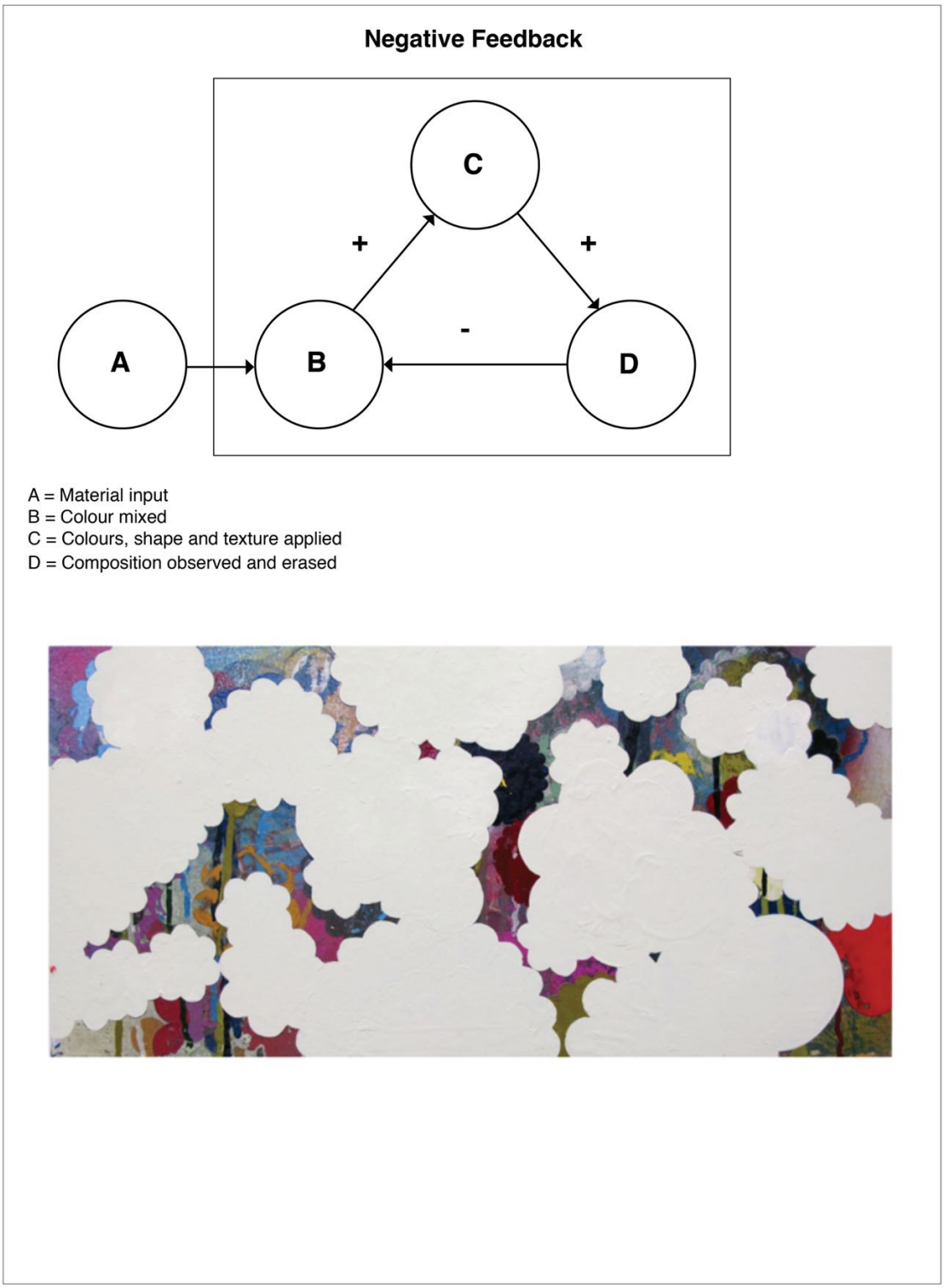


Figure 11

Negative Feedback

Material is input into the system, (A), where the colours are mixed, (B), before being translated into shapes and texture. The effect of the addition is then observed, (D), and elements are erased from the painting and this information is fed back to influence the next layer of the painting.

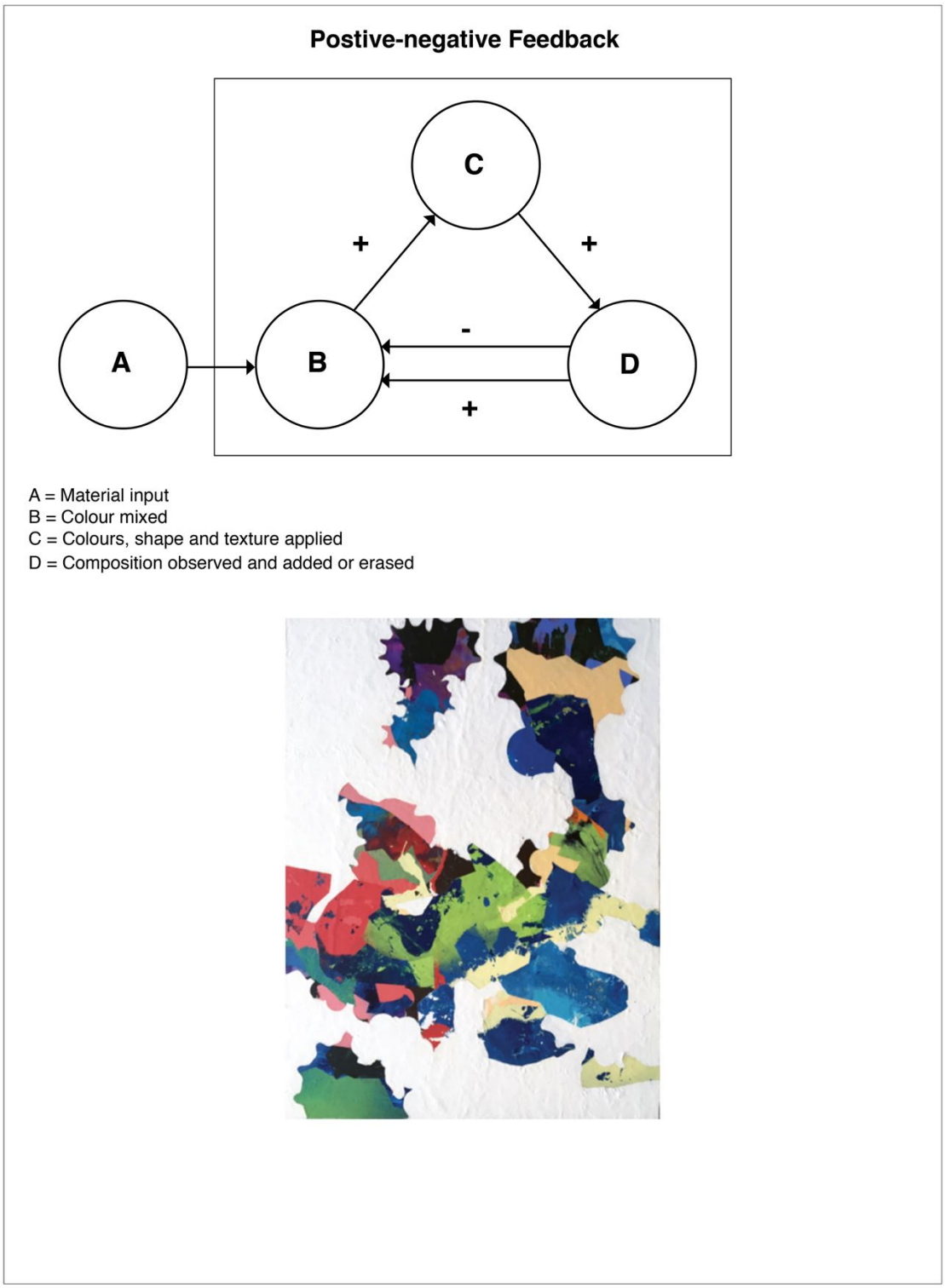


Figure 12

Positive-Negative Feedback

Material is input into the system, (A), where the colours are mixed, (B), before being translated into shapes and texture. The effect of the addition is then observed, (D), and elements are either added or erased from the painting and this information is fed back to influence the next layer of the painting.

Noise

Noise also operates within the painting on several levels, and can be understood in relation to the signal, noise and message equation discussed in chapter 3. As noted the messages embedded within a complex system may be unknown to the artist, and it is through the production of the work that these are revealed to both the artist and wider audience. The artist therefore operates as both encoder and decoder of the message. Whilst the signal in terms of a rule-based work can be understood as the rules and the clarity of those signals is dependent on their transmission through the work. The noise in this example is an unspecified mutation or glitch that is added to the work by the artist to disrupt the message, and in doing so the decoder must pay greater attention to the underlying patterns from the signal structure. Thus, the noise has three functional roles in a system. Firstly, it demonstrates the underlying structure and patterns, by forcing the viewer to give the emergent differences attention. Secondly, it operates as a DNA-like mutation in which the deviation is seen as adaptively competitive and can absorbed into future iterations of the rules through feedback mechanism. Morton described this creative feedback process, as 'improvisation is adaptation, plus awareness'. (Morton, 2012, p. 109) Finally, the disruption of the system creates interesting fissures within the work from which new meanings emerge. Levinas described such mutation with 'Contamination is functional', and mapped this to language noting that, 'for meaning to happen, language must be noisy, messy, fuzzy, grainy, vague, and slippery. Evolution consists of incremental quantitative changes, not qualitative ones'. (Levinas cited in Morton, 2012, p. 66). Thus, art disrupts the simple closed system by mixing signal, noise and message into a single work. Consequently, the information in the work should be disrupted by noise for the recipient to actively engage in decoding, as the message may be too deep within the artists' psyche, or too complex for the artist to transfer as a clean signal.

Ecosystems

Ecosystems

The distinction between the seemingly independent objects, (paintings, films, drawings and photographs), and the descriptive ecosystem, which describe their underlying functional unity is a central interest in my practice. Barry Schwabsky noted that the dialectical relationship between the object and the overarching system has been a concern since early Romanticism, and he quotes a statement from Friedrich von Schlegel in 1798 'A project is the subjective embryo of a developing object' (Myers, 2011, p. 77).

We can substitute the term 'project' with 'system' and the concern feels a very contemporary one, as an artist must decide whether the subject of their enquiry can be contained within singular objects, or whether they can only be revealed over time through a complex distribution of work. Schwabsky suggests that this points to an ontological problem with object-based works such as paintings. As he states,

> 'if we look at a painting we think we are looking at an object. And if the unit of artistic evaluation and analysis is the project, (*system*), rather than the object, then we might feel that in this painting/object we are facing something of lesser status, like a Platonist looking at a mere chair when what he really wants to do is contemplate an idea'. (Myers, 2011, p. 77)

The degree to which this is an issue for an artist is dependent upon whether they want to communicate specific information and messages to the audience. If the intention is to create an informationally rich environment and the artists is open to the flow of information through the work then the system, allows for this dynamism. As Schwabsky concludes, the nature of the project (system), 'is to be in progress, in development - to be incomplete and unfolding, and above all to be subject to revision…And that, in turn, means that you never get to look at it straight on' (Myers, 2011, p. 77).

I understand that the works I create in terms of systems, and the model of the ecosystem introduced in Chapter 2 is a useful model, as it helps describe the simple underlying morphological processes that affect change within a work, (the rules of production), but at the same time it can describe the whole ecosystem of the artwork. Thus, it can describe a simple mechanical process employed in the production of a work, but it can also describe the wider environment in which the work operates. Even the relatively simple rule-based works described in the previous section are produced as a series, and as such they are part of a wider system of works that encompass the rules of production and the outputs of the rules.

As noted in Chapter 2 systems can also be understood as Isolated, Closed or Open Systems, and this can be usefully applied to artworks. Isolated systems in the physical world are more of a theoretical model than something that is practically observed. This is true also within art, as isolated systems can only exist in the studio, and are a transaction between the artist, their ideas and material, with the studio acting like a vacuum-sealed bell jar, in the sense that as soon as the seal is broken, the work cannot possibly be free of other influences. A closed system is one in which all of the circulation of materials and information is contained within the boundaries of the system, like a terrarium. Hans Haacke's early systems work, in which he focussed on biological, ecological and cybernetics processes operated in this way. An example of this is the *Condensation Cube* (1965), which consisted of a completely sealed transparent Plexiglas cube that contained a small proportion of water, relative to the volume of the space. Due to the heat exchanges taking place within the cube the water cycled through liquid and vapour states.

My work 'Bleed and Blend', (2012-ongoing) is an on-going project that can be described as a closed system. The work is created by streaming information into the closed system in much the same way that the sun's heat is the only input in Haackes' terrarium. Data values are translated into a colour system, and as these spots of colour flow down the screen over time they begin to merge and fade. The number of streams, the variation in colour and the speed of change and movement are dependent on the data supplied. This work can be considered as a closed system, as only one variable within the system is controlled from outside of the boundary of the system. Emergent patterns may become visible from these streams, such as spatial correlations and temporal patterns, but their influence does not leak out of the work. A version of this system was commissioned by Culture Lab, Newcastle, (2012), which operated with a live data feed of pollution sensors distributed across Newcastle. This was projected onto a building in the city centre at night to give a subliminal or ambient sense of air quality. This publicly presented version of the work cannot, however, be described as a closed system, as it is part of a wider circulation of materials and it would therefore be understood as an Open system.

In reality most contemporary artworks operate as complex or open systems once they have left the studio as they operate through the exchange of information and messages with an audience and these are subject to change over time. The installations of Jason Rhoades, are a stark and literal example of complex systems, as

they were constructed from vast amounts of material, and not only did they exchange information, but the materials were re-used and circulated between different iterations of the work. Thus, there was a huge circulation of material and information entering and leaving the system and stability of the work was sustained through this dynamism. Thus, a work, such as 'The Creation Myth,' (Jason Rhoades, 1998) was a dynamic ecosystem, and Rhoades was the planetary force that sustained that top-down equilibrium. Without the direction of Rhoades the integrity of the original system is disrupted and the boundaries of the work will inevitably change, as the work becomes part of a wider institutional dialogue, as since the death of Rhoades the boundary of 'The Creation Myth' has expanded to encompass institutional processes.

This relates to Jack Burnham's expanded notion of what can be included in the description of a systems art object. In *Systems Esthetics*, (1968) he suggested that dealing with the, 'problem of boundary concepts. In systems perspective, there are no contrived confines such as the theater proscenium or picture frame. Conceptual focus rather than material limits define the systems' (Shanken, p.115, 1968). Thus, in ecosystem terms the boundary of 'The Creation Myth' would need to be expanded to encompass the now active role the curation and exhibition process plays in its sustainability.

System Walks

A central project within my practice is the category of work called ‘System Walks’, and these can be understood as Ecosystems. These are complex works, which unfold in different ways and create a space, both literal and metaphorical in which I can investigate the abstract questions I have in relation to phenomena and how these are mediated and experienced in spatiotemporal and systems terms. System Walks originate directly from my experiences in environmental work, as walking was a central aspect of the data validation process, known as Ground-truthing. This is the practice of corroborating data in Geography and Environmental Science through surveying the area of interest on foot to see whether the phenomena suggested in the satellite images, maps or data actually physically exists on the ground. This work also acknowledges the broader incorporation of walking within Conceptual and Systems Art, which in turn trace the act of walking back through from Psychogeography, Surrealism, and Dada.

Thus, I used to walk within a technical and ecological context to understand the world and how this had been passively captured as data from satellites, or translated into information by subject specialists, such as soil scientists or botanists. The data once validated would be turned into four-dimensional data maps within the information system and these could be investigated either in terms of area or path. Thus, abstractions of space and time could be extracted and considered in ways that one cannot experience in the material world. As one could, in assemblage terms, deterritorialise and reterritorialise phenomena, (or their data simulation), to consider relationships that are not observably present on the ground. Thus, the availability of the whole simulation of the subject, and the ability of moving through the simulation at different scales of time and space created a flat ontology, as everything within the simulation became equally available. This unfolding or access to the world, albeit in simulated form, created a rupture in my psyche, which is the basis of all my activity as an artist. As I found the more information I had about the world the more the simulation unfolded, and the world I believed existed, the ‘thing-in-itself' retreated further from view. Morton, as already noted in thesis, made this point very clearly.

> ‘The more information we acquire in the greedy pursuit of seeing everything, the more our sense of a deep, rich, coherent world will appear unavailable: it will seem to have faded into the past (nostalgia) or to belong only to others (primitivism). Some of us will eventually think that we once inhabited this deep, rich, lost world. Others will realize that even this sense of loss is an illusion created by our current modes of seeing. (Morton, 2012, pp. 55–56)

This understanding is both performed and expanded through the production of these walks.

Thus, the flatness, the sense of excess and the 'nostalgia', or saudade I felt through the interactions with these systems is a similar experience everyone now has due to the Post System condition. Nick Fisher, (2014) suggests the tendency to understand things in terms of linear historical progression, is a pre-millennial condition, and we are moving towards a flat ontology where everything is equally available as a secondary experience, or simulation. He argues that the cognitive dissonance felt by this flattening of time and access is something only the pre-millennials feel. There is, however, a nagging suspicion that our discomfort is more than neophobia, but an understanding that we need stories, (unmediated by Google), and temporality to structure the past, (and future). The underlying contention of this thesis is that our Post-System condition requires our stories to be more complex than linear narrative; and instead should be constructed as complex, but structurally transparent systems in which multiple meanings are derived.

Several observations can be unpacked here in relation to nostalgia, saudade and the uncanny. The term saudade is used through the thesis to describe the feelings I have had for a sensed loss, of what could have been in terms of an ecological-technological future, which did not unfold in a way that protected our lifeworld. This saudade shows itself within culture in different forms, such as the retro aesthetic within art, fashion and music. For example, the composer Jóhann Jóhannsson's five-part score 'IBM 1401, A User's Manual', (2006), is based on a 1959 audio recording of someone reading a computer manual. The 'IBM 1401' was an early computer and the tone of both the work and the manual suggest something fragile, once new, but now lost. Jameson describes this as 'nostalgia mode', and although describing mainstream cinemas obsession with period films, this description captures a withdrawal into a fabricated past and the sense of loss that our flat world elicits.

> 'It seems to me exceedingly symptomatic to find the very style of nostalgia films invading and colonizing even those movies today which have contemporary settings, as though, for some reason, we were unable today to focus our own present, as though we had become incapable of achieving aesthetic representations of our own current experience. But if that is so, then it is a terrible indictment of consumer capitalism itself – or, at the very least, an alarming and pathological symptom of a society that has become incapable of dealing with time and history.' (Jameson, 2009, pp. 9–10)

The other issue that comes to the surface within the flat ontology of the post systems condition is the uncanny and this is something I experience within the system walks. Firstly, the production of photographs during the walk fixes the experience into the past in a way that can never be fully retrieved, even within the simulation. As there is paradox at the heart of our flat world, which separates what is experienced in the embodied world and what is experienced within the simulation. As in the simulation one can move forward and backwards in time, and one can occupy space at different scales, or draw a line between two events, which occupy different realities. Thus, a systems-based reality is multicursal and multidimensional, but our experience of living and breathing is unicursal on the material level.

That is, on the material level we experience and understand time as unfolding in a linear unicursal way. Within the wave-particle duality of the material world we are temporarily held together as a 'person', and our lifeworld is the compound effect of feedback loops within our material-mental system. Our bodies are structured from cells and as these age so do we. Thus we experience life as unfolding along the axis of time and the psychologist James Gibson suggested that, 'we perceive the world along a path of observation' (Ingold, 2016, p. 87). Thus, we think of life in terms of a path with potential branches, both real and imagined in which we could choose to go in one direction or another. On a walk if a selected path is a mistake we can return to the fork in the road and select another path. This return is, however a spatial and not spatiotemporal, as the original fork in the road is not accessible as the axis of time is unidirectional. This is why photographs may contain the uncanny and induce a profound sense of saudade, as they present something's inaccessibility. That is, we can return to somewhere spatially, but we can never return to somewhere spatiotemporally. As Morton suggests, 'the uncanny exists because we're always somewhere. Repetition, with its play of familiarity and difference, is thus possible' (Morton, 2012, p. 52). Thus, the walks within my practice are usually repeated several times, as the play of difference that the repetition elicits both refines the inner simulation of the world whilst confirming the external worlds withdrawal. Consequently, the photographs operate as markers within space-time confirming that our experience of the world is conducted along the fixed axis of time, which makes each attempted return such a bitter-sweet experience, as the return can never be fully realised. In the same way that the complexity of the tea balanced the sweetness of the madeleine for Proust so the bitter-sweetness of this realisation helps us to be more fully present in the moment.

Thus, there is something small, but significant to be considered from Proust in relation to the melancholic pleasure of the return experienced in the walks, or the reconsideration and reliving of the walks through making. Proust used the term ‘moments bienheureux’ to describe these encounters and the term is translatable as a ‘blissful moment’ and this is something very different to the destabilising quality of déjà vu. (Lennon, 2007, pp. 55) Thomas Lennon suggests the difference between bienheureux and déjà vu is that bienheureux channels truthful sensations from the past. Thus, although we can never fully return to the same place, the same phenomenological sensations can be activated through the return; through repetition, sight, touch and smell. Lennon described Proust’s activation of the past through bienheureux, ‘a revelation of something like Platonic forms, but forms that are embedded in time, the object of a special sort of sensation’ (Lennon, 2007, pp. 64). Later he revises his thinking and argues that whilst the revelations were platonic and universal, they were also something more profound as Proust found ‘himself rooted in time.’ (Lennon, 2007, pp. 64)

Thus, as systems and the increasingly flat ontology of things unfold our world at the level of simulation the understanding that we are rooted in time is of paramount importance to our sense of self, as without it the ‘present’ will be relegated to one-of-many dimensions of hyper reality. These spatial and temporal thoughts and dislocations unfolded from my work with multi-dimensional environmental data, which describe and simulate complex space. Whilst these walks help me unfold my understanding of this complexity, and ground my experience in space, sensation and materials.

The primary difference between the original scientific ground-truthing walks and the System Walks introduced here is scale and intention. As instead of working on a project that deals with huge datasets that span vast geographical regions, such as the Andes a typical walk may be dealing with a modest stretch of coastline, a walk through a park, or a mental unfolding of an idea, book or film. The motivation and intention of the System Walk is different to a strictly geographic, ecological or scientific project as these projects are designed in an open way. Thus, I am not asking specific questions in advance on these walks, such as ‘what is the correlation between altitude and Roseroot (Rhodiole rosea) abundance’, instead the walks become a developmental space in which questions can be revealed, methods tested, and various threads explored. As suggested in the thesis an ecosystem is both a space and story, which helps describe, what is seen and understood. Thus, some things within a walk are

upwardly revealed through morphological processes, such as a rule, which generates patterns within the work, whilst other things emerge through the completion of the project and can only be described in downwardly causal, or retrospective terms. Some things can be described within hierarchies, whilst other things may break free of these functional structures.

System Walks can be described as conceptual, in the sense that they are based on an idea. These ideas could be either a formal aesthetic concern, such as the abstract representation of light and colour, or a more poetic concern that relates to something associated with the time or place; whilst other walks may be informed by narrower conceptual ideas, such as the methodology of data collection, or the topography of place. A time-lapse camera is worn to capture the walk and a GPS records the positional information; whilst a small notebook is used to record observations, and a map or book may be referred to for directions or context. Drawings, photographs, films and paintings are produced, during or after the walk and these can be considered as system outputs, rather than individual artworks. Instead, the whole ecosystem of things including the walk, the invested energy and the outputs is the artwork. Collecting experience and information in this way is a personal attempt to bring the abstract information approaches of mapping and information systems along side the conceptual, affective and aesthetic approaches of art, and explicitly rein control of the systems employed in my practice. This duality of the objective, but abstracted information with the subjective, but experienced information is accommodated in the ideas of Psychogeography and I take their ideas as a point of reference and inspiration.

The walking projects operate on several levels. Primarily they are a bounded system, an ecosystem, which can evolve over time, and allow work to grow and extend. Each walk starts with a subject, a location, route, map, book or film; but the underlying idea is in the undertow, and the walk and the making attempts to pull it closer to the surface. On a practical level the walk allows me to collect material and information required to create new work. The walk also allows me to physically engage with something on a deeper affective level and reactivate my connection with time and place. Finally, the walk helps define the work, in systems terms by supplying the key inputs of energy and information. This investment of ideas and energy in the systems is through the mental and physical engagement required to make the walk and the material and information collected on the walk. If there is an underlying ‘message’ in these walks it is to express this dialectical relationship I have with the world, which is physical and

mental; physical and technological, material and relational. Walking allows this dialectical relationship, as Van Den Boogaard suggests,

> ‘Walking is a way of becoming unstuck from yourself, of merging with your environment: the boundary between yourself and the environment is relinquished. A cosmic unity is restored. It is about a dematerialization of the self, dissolution into space, becoming part of the geography. In the meantime, you shape something new; you become movement, measure, scale, direction, dimension and space.’ (Van Den Boogaard, 2014, p. 120)

Lola Gehen, (2014-2017)

We can consider the walks in more detail here by referring to several examples, beginning with ‘Lola Gehen’, (2014-2017). As noted each walk has an initial motivating idea, or subject of interest. In the case of ‘Lola Gehen’ it draws from the film ‘Lola Rentt’, (Tywker, 1998) and the way in which the topology of Berlin was enfolded to make narrative sense in the film. Thus, in this project I thought about the difference between ‘true’ geographic topology and the folded, networked space that requires a more flexible aspatial description. The film ‘Lola Rentt’ is structured in three acts, and each act is the same scenario repeated, where the protagonist Lola must cross Berlin in a fixed time. Each time the act is repeated a slight, seemingly inconsequential change occurs, and the film follows Lola as these changes create slippage and difference between the acts. Thus, I repeated this walk three times over three visits to Berlin, and mapped the differences between the walks. I recreated the route through the city so that I could take in all the key scenes of the film in a single walk. This meant that the city was unfolded as the 27 Km route re-ordered the scenes of the film. In terms of system outputs for ‘Lola Gehen’ I created a series of constructed photographs. Whilst the wider ecosystem of the work includes the idea of the work, the invested energy in the walk, and the original idea derived from Lola Rentt. This film in turn drew inspiration from Krzysztof Kieślowski's film 'Blind Chance', (1981) which dealt with the idea of chance, random difference, and a journey repeated. So, in community or ANT terms Blind Chance, Lola Rentt, and Lola Gehen can be held together. See figures 13 and 14.

The constructed digital photographs for Lola Gehen were constructed from the three colour channels, red, green and blue, (or RGB), which were blended together to create a full colour spectrum. The photographs in the 3-Channel Photographs series, (figures 13 and 14), were constructed from 3 sets of photographs, as the walk was repeated through Berlin three times, in 2014, 2015 and 2017. The red colour channel was extracted from the walk in 2014, the green channel was extracted from the walk in 2015 and blue channel was extracted from the walk in 2017. Thus, the images created are completely numerical in construction and bare equal relation to each of the three walks and experiences. The photographs show the interesting slippages of colour, time and space taking place. For example, if grass is overlaid from the three walks then the RGB values will combine to create the appropriate colour. Whereas, if there is a strong spatial and temporal shift between the repeated walks, then the RGB channels will not blend together and there will be stark compositions and discrete blocks of colour. A

second example is included for the walk Rosa-Luxemburg-Platz, (2011-2017). See Figures 15 and 16.

Rosa-Luxemburg-Platz, (2011-2017)

This slippage of time and space and colour is further unfolded with a walk that has been repeated many times in Prenzlauer Berg, (figures 17 and 18). 'Rosa-Luxemburg-Platz', (2011-2017) is a circular walk that has been repeated every year since 2011 and begins and ends on Rosa-Luxemburg-Platz at the Kino Babylon cinema and Volksbühne; as these buildings represent the two poles of lens-based media and performance in Berlin. The route also originally took in several key galleries in this district, although some of these have moved or closed in the intervening years. I originally made the walk when attending a film Conference at Kino Babylon and I was interested in the constellation of film, performance and visual art in this relatively small corner of Berlin. I have attended many art events in the area, but my personal and psychogeographic understanding of Berlin remains predominantly spatial and resists linear documentation through film. During these walks I was struck by the problematic relationship my practice has with moving image, as I draw from many of the ideas and the mechanics of film and animation, but most of my work can be understood as a multicursal system. I think I am interested in the gaps between the works as much as the works themselves, and unlike film or animation a series of constructed images or paintings give the viewer the space in which to imagine the transformations and interpolations that have taken place from object A to object B.

Spot Samples

This interesting space between the separate objects is demonstrated in the series of 'Spot sample' photographs created on one of the walks around Rosa-Luxemburg-Platz. A single colour is sampled from each photograph in the series and these are superimposed back onto the photographs. This creates an interesting interplay between the path taken on the walk and the path taken through the photographs as the colours are sampled. I developed a software tool, which affords an intuitive interaction with the series of photographs, and I extract the colours using a digital drawing tablet and pen. This walk was repeated at different times of the year and the colours changed significantly. See Figures 17-20.

Avec Nadja, (2017-2018)

'Avec Nadja' the project is an attempt to retrace the steps of Andre Breton in his surrealist autobiography Nadja, (1928), in which he described Paris and the semi-mythical character of Nadja. This surrealist text is narratively complex, due to its non-linear structure, its dislocation of space and its fictionalised use of photographs, which prefigures the work of the Atlas Group mentioned in Chapter 3. There is something sad, erased and spectral about the character of Nadja in the text, and you can feel the slippage between the life of Léona Camile Ghislaine Delacourt, the basis of the character Nadja and the amalgam presented in the book.

This walk through Paris is of particular interest to Psychogeographers, as it triangulates the three key psychogeographic interests of Breton, the flâneur, Paris, the home of psychogeography, and Nadja, as a surrealist encounter between fact and fiction. In planning I consulted several online discussions, regarding the challenge of mapping the walk, and I also discussed possible routes with the philosopher Bruce Baugh who shares an interest in Breton and had walked the book over a three-day period in 2008. Although Baugh's route through the book and city were interesting I designed a route, which created a single walk, as I wanted to repeat it on two consecutive days.

To do this I had to re-read the book several times as I attempted to build a route through Paris from Nadja's perspective and start from her hotel, Hotel du Théatre, 5, rue de Cheroy, 17th arrondissement, off the boulevard des Batignolles. I then pieced together a path from the fragmentary encounters between Nadja and Breton, such as their first meeting at Place Franz Liszt, formerly Place La Fayette. Their meeting at the hotel café at Gare du Nord, which would probably be the Hotel Terminus, judging from the description. The route also included the Place du Panthéon, passing the Hotel des Grands Hommes, which Breton described as the start of their adventures. The route meandered east then south to the Seine finishing along the Quai de l'Horloge. These locations where used to create a map which was used to navigate the city. I repeated this walk over two consecutive days and recorded the experience with the camera, a colour sensor and drawings, and these were used as the basis for the production of a range of works.

When I make these walks, even in a busy place the experience is very different from a normal walk in the city. I feel to some degree invisible as I am focused on the purpose of the walk and do not engage in contact with others. The process draws inspiration

from the ‘non-performance’ performances of Vito Acconci’s ‘Following Piece’, (1969), and Adrian Piper’s Catalysis series, (1970-1971). In that the walk is part of the work, but the people I intersect with during the walk are not the audience, or aware that a work is being made; and like Acconci the walks are carried out under research conditions, with clear rules of how the activity is documented.

Ghost photographs

The primary work I wished to make from these walks were ‘Ghost photographs’ through the process of double exposure of the photographs taken during the two-day walk. The ‘Ghost Photographs’ have been employed in a number of repeated walks across Europe, but the idea originally derived from the atmosphere and spectral language employed in the book Nadja, as both Breton as the narrator, Nadja as the person slowly lost and the blank photographs of Paris operate as ghostly images. This spectral sense is established in Breton’s opening lines, ‘who am I? If this once I were to rely on a proverb, then perhaps everything would amount to knowing whom I haunt.’ (Breton, 1960, p.11) And even more poignantly,

> ‘My image of the "ghost," including everything conventional about its appearance as well as its blind submission to certain contingencies of time and place, is particularly significant for me as the finite representation of a torment that may be eternal. Perhaps my life is nothing but an image of this kind; perhaps I am doomed to retrace my steps under the illusion that I am exploring, doomed to try and learn what I should simply recognize, learning a mere fraction of what I have forgotten. (Breton, 1960, p.12)

These photographs, (see figure 21), are created by repeating the walk and double-exposing the photographs from the two walks to create a new third series of images. Thus, on each day the first photograph was taken outside of Hotel du Théatre, on rue de Cheroy, and the last photograph is taken at the edge of the Quai de l'Horloge looking along the Seine. Through this process of double exposure small differences between each walk, such as the path taken, the weather, or the configuration of pedestrians, create small but significant afterimage distortions that have an atmosphere redolent of the text. An interesting aspect of these images is the role the noise, distortion or mutation plays in the construction of the image. Whilst noise is seen as a problematic interference in communication terms, it is a necessary disruption within art to reveal the hidden messages present in the intersecting streams of information. The Ghost Photographs are grey-scale images, and the disruption caused by mixing the two streams of information can be seen as intentional, but uncontrollable noise. Several examples of these photographs are included here.

Figures 21 and 22, Avec Nadja, Paris, 2017

Figures 24 and 24, Berlin, 2012-2013

Figures 25 and 26, Berlin, 2013-2014

Figures 27 and 28, Three Brethren, 2014-2015

Direct colour samples

In addition to the spectral ghost photographs I collected colours samples during the two-day walk in both direct and indirect ways. The direct samples were collected during the walks using a very accurate 'Nix' colour sensor. Following the path through the city I imagined what had changed and what had remained the same from the Paris Nadja and Breton would have experienced. If I saw something that I felt would have changed little I took a sample of the colour using the sensor. For example, colour samples were taken of the Euphorbia, growing semi-wild along the boulevard des Batignolles, the painted streetlamps on Boulevard de Bonne Nouvelle, or the paintwork on the glove shop referred to in the text at Jardins du Palais Royal. The full list of selected colours was compiled in a colour chart, (figure 29), which gives a description of the selected subject, its location and the colour as an RGB value.

Secondary colour samples

A second indirect method of colour sampling is employed in the system walks in which the series of photographs that mark out the walk are each reduced to a single colour sample. As noted earlier I have developed a software tool, which allows a fluid interaction with the photographs, which play as a film sequence, and I extract the colours using a digital drawing tablet and pen. The film runs through each frame slowly, at a frame rate of 1 frame per second. As the photographs were collected on a time-lapse camera, with a 10-second interval between frames each second of drawing is the equivalent of 10 seconds of the walk. Thus if the walk took 3 hours to complete, the selection process with the pen would take 18 minutes to complete.

The colours are selected through the movement of the pen, as a single line is drawn for the duration of the sampling process. The sampled colours are laid out as a grid of colours, starting in the upper left-hand corner of the work and across from left to right in rows. This construction therefore does not represent coordinate space, like a satellite image, but an abstraction of colour, space and time. Figures 30 and 31 show the walk repeated twice over a two-day period, and each square represents a single sample of colour, 10 seconds apart. As it is the same walk repeated a day apart, the variation in colour both represents the difference in light conditions and the colours I was attracted to at the time of sampling. Thus, the variation between the two works reflects both the variation in the information, and the variation in the subjective decisions I made in selection process. Thus, these are abstractions of abstractions.

On another level I am interested in what this work suggests in terms of the subjectivity of sampling and selection processes employed. This is illustrated through the iterative interrogation of the data, as each time I interact with the material at the drawing stage a slightly different line and set of colours are created. Thus, underlying these works is the suggestion that all sampling of data or accessing of information is to some degree subjective and is influenced by things that are not described by the system. For example, there is a level of subjectivity in the original selection of colours in the direct colour samples, informed by the deep reading of the book Nadja. Likewise, the colours selected through the secondary process of selecting colours from the photographs is a subjective decision, but the selection is subject to what the camera sensor captured, as this is a product of the lighting conditions. Further than this the selection of these colours during the drawing-sampling stage is subjective and will be influenced by the colours I am drawn to, and the desire to 'represent' how it felt at the time of the walk. I am thus experiencing a 'double-haunting' of the present as I interact and activate these past materials.

It also needs to be acknowledged that there is an affective experience for myself in the production of the work, particularly during the walking stage, as these bodily experiences are pitted against the other more abstracted secondary information of data. Although affectivity is not directly addressed in the thesis, the experiential affects of the walk need to be acknowledged as it grounds the body in the present. For this narrow purpose we can see affectivity and unmediated emotion as being substitutable, as Brian Massumi notes, 'there is no cultural-theoretical vocabulary specific to affect. Our entire vocabulary has derived from theories of signification that are still wedded to structure' (Meltzer, 2013, p. 24). The three categories of affect: 'motivational intensity', 'arousal' and 'valence' cited are useful though in pinpointing these experiences. (Gregg & Seigworth, 2010) Thus during a walk I have experienced the affect of 'motivational intensity', or a compulsion to walk or climb. Secondly, I have experienced 'arousal', or the body unconsciously reacting to physical engagement. Thirdly, I have experienced 'valence', that is, an emotional dimension brought on by fear or moments bienheureux; or in the case of Nadja the feeling of 'Saudade' or an intense melancholy for something that is now absent.

Trace Drawings

As noted, to sample the colours from the walk a continuous line is drawn across the film for its duration. This drawn line is recorded by the computer and drawing tablet and operates as a secondary walk through the sequence of images. During the construction of this line the original walk is remembered and reactivated. These lines can be understood as an interesting by-product or trace, as they are created as I look at the screen and not my hand. They thus fall into the category of 'Trace' information in terms of Bates' categories of information as they literally trace out how I engaged with the visual material as I ran my hand across the tablet to select colours.

However, these Traces become interesting objects in their own right, as through repetition a pattern of line emerges, that can be observed, but would be very difficult to describe geometrically. This can be seen in figure 32, which shows nine recorded traces from the same walk repeated three times over three years. Each row denotes a year and each line denotes that year being resampled or retraced. From this you can see that the traces in each row have more in common shape-wise within their year, meaning that even though the lines were drawn subjectively, I was drawn to the same sets of colours on a given year.

This can be related to Walter Benjamin analysis of technology as transforming the spatio-temporal co-ordinates of experience. He used the Lithograph to illustrate this point noting that whilst it is capable of producing many copies of a work, each will be unique to the time and place it was produced due to the inherent variability in the process. Likewise, the systems employed here to produce these works in real-time captures a unique work, that whilst based on the original source material is a specific response to the material and the gestures employed at the time of interaction. The systems employed are therefore not merely reproducing the information produced during the original experience of the walk as it is mediated by the second space-time experience of the interaction to produce something original each time the interaction takes place. Thus, each time I engage with the information there is an expansion of the information, and the original subject is in danger of obscurement. Thus, there is a complex dialectic in operation within this and many of the processes employed in my practice; as efforts made to elicit the underlying patterns in the world increase its complexity and removal. As Morton notes,

> 'Since our psyche is always disturbing—it takes so long to contruct one, and there are so many rules for its construction—it is disquieting to see an image of our psyche in the external world, in the form of repeating patterns. It's our

> own artificiality, projected onto the outside world. The repetition involves an uneasy sense of emptiness.' (Morton, 2012, p. 54)

This technique of selecting colours has been employed in a number of ways on walking and sampling projects as I seek to find an intuitive route through the data. Figures 33-36 show the path through the data samples for each day of the Paris walk. I created these by drawing a line on the digital drawing tablet. I taped together the tablet pen and a dry point etching tool, and I incised a single path onto the etching plate for each walk. This required a much higher degree of concentration and force than the purely digital drawing process, and this is evidenced in the resultant etchings, (figures 37 and 38).

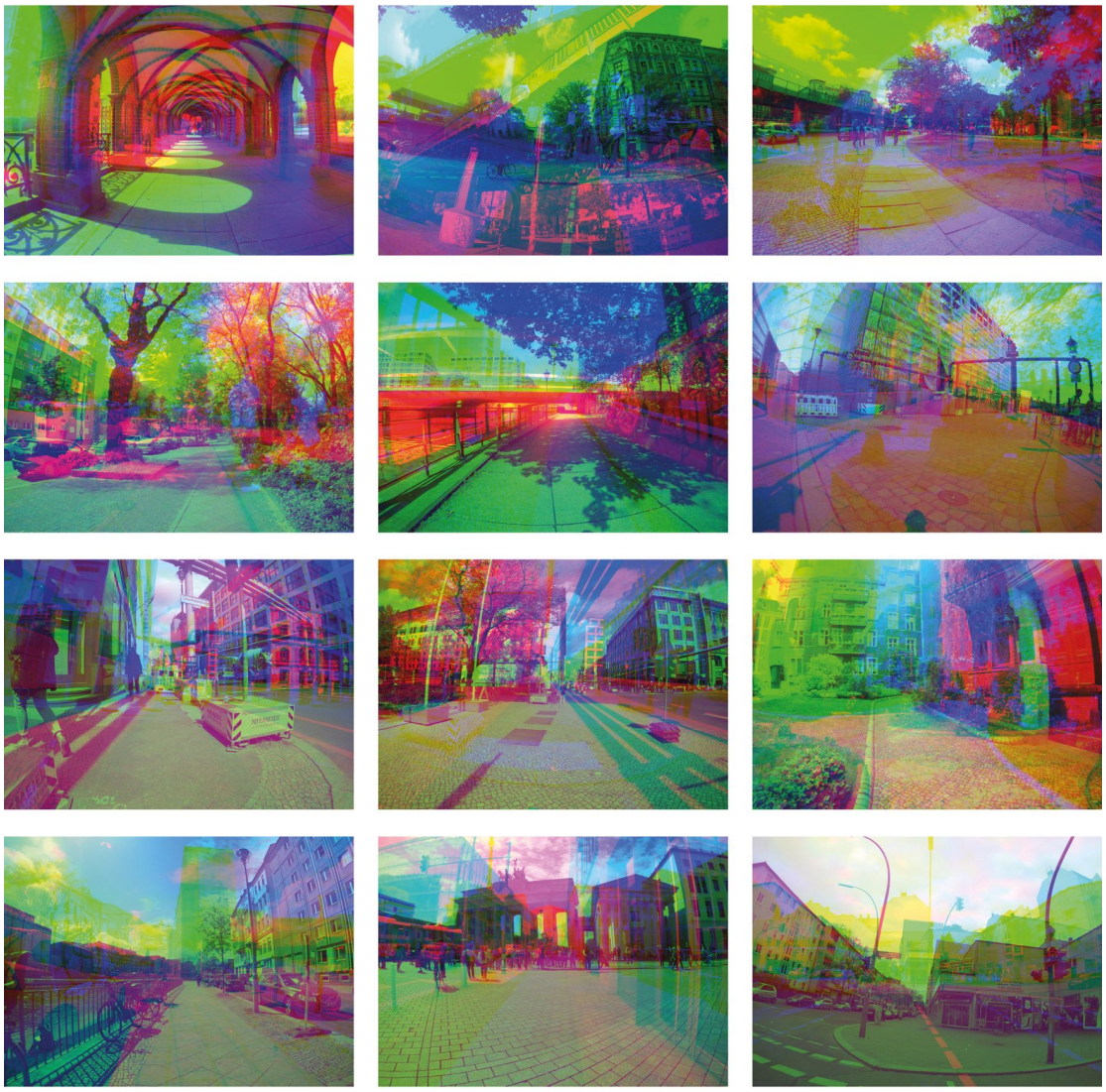


Figure 13

Lola Gehen, (2014-2017)

RGB Constructed Photographs

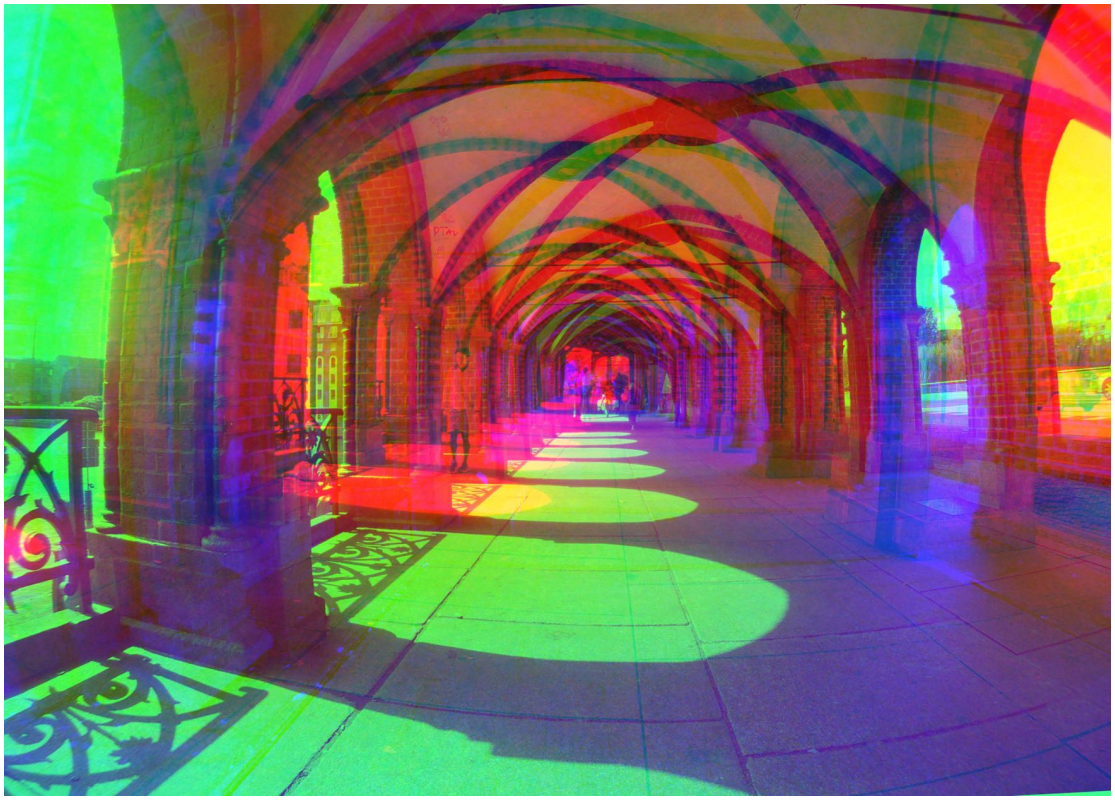


Figure 14

Lola Gehen, (2014-2017), Oberbaumbrücke

RGB Constructed Photographs

Figure 15

Rosa-Luxemburg-Platz, (2011-2017)

RGB Constructed Photographs

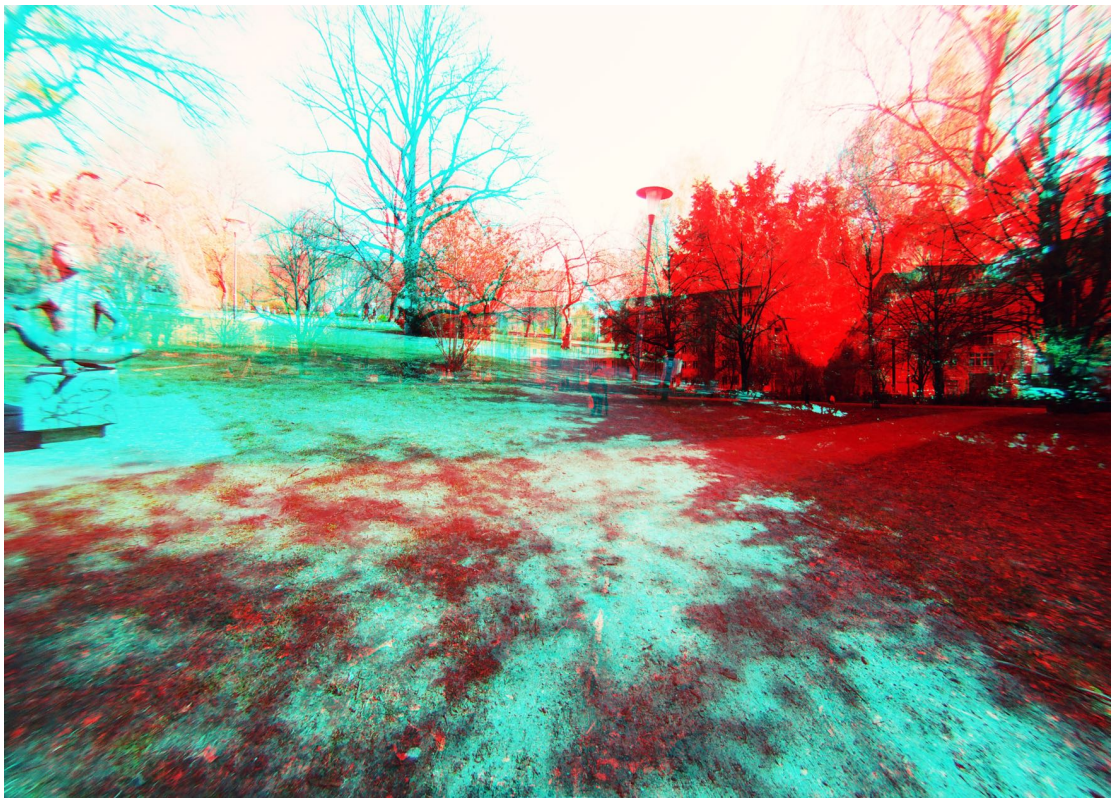


Figure 16

Rosa-Luxemburg-Platz, (2011-2017), Der blaue Spielplatz

RGB Constructed Photographs

Figure 17

Rosa-Luxemburg-Platz, (2012)

Spot Sample Photographs

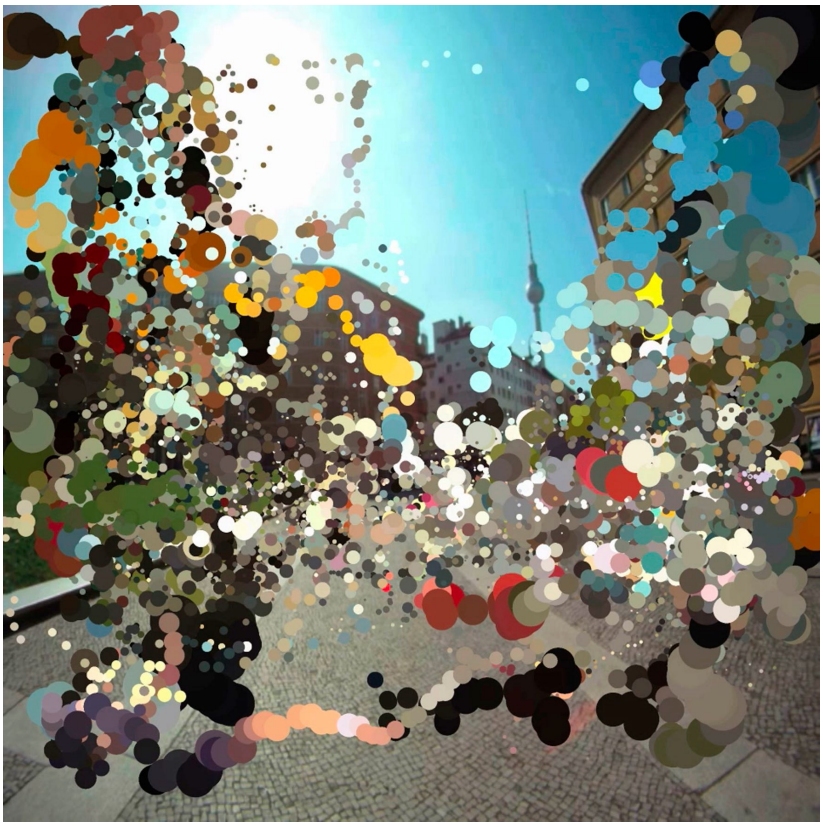


Figure 18

Rosa-Luxemburg-Platz, (2012)

Spot Sample Photographs

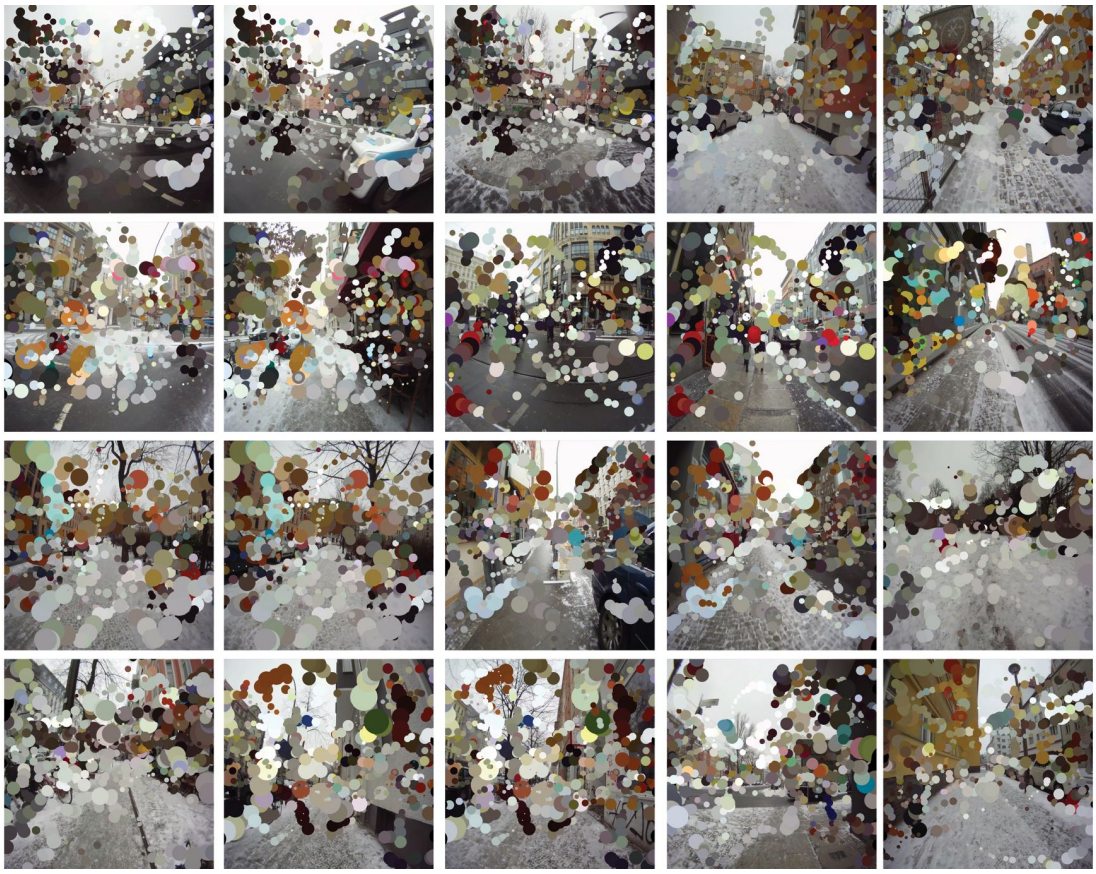


Figure 19

Rosa-Luxemburg-Platz, (2013)

Spot Sample Photographs

Figure 20

Rosa-Luxemburg-Platz, (2014)

Spot Sample Photographs

Figure 21

Avec Nadja, (2017-2018)

Ghost Photographs

Figure 22

Avec Nadja, (2017-2018), ‘Librarie Des Alpes’

Ghost Photographs

Figure 23

Berlin, (2012-2013)

Ghost Photographs

Figure 24

Berlin, (2012-2013), (detail)

Ghost Photographs

Figure 25

Berlin, (2013-2014)

Ghost Photographs

Figure 26

Berlin, (2013-2014), (detail)

Ghost Photographs

Figure 27

Three Brethren, (2014-2015)

Ghost Photographs

Figure 28

Three Brethren, (2014-2015), (detail)

Ghost Photographs

Object	Location	Red	Green	Blue	Colour
View from Nadja's Hotel	Rue de Cheroy	211	192	161	
Euphorbia	Boulevard des Batignolles	148	150	55	
Side entrance Moulin Rouge	Rue Lepic	131	20	29	
Stonework of Station	Île-de-France	197	185	168	
Main doors of station	Île-de-France	177	161	141	
Terminus Cafe door	Rue de Dunkerque	130	146	142	
Terminus Cafe paintwork	Rue de Dunkerque	60	35	33	
Metro metalwork	Boulevard de Denain	60	76	69	
Les Marches des Paris	Rue de Chabrol	45	53	49	
Chocolatier	Rue Vivienne	22	67	56	
Magnolia	Jardin du Palais Royal	229	195	208	
Magnolia	Jardin du Palais Royal	87	44	65	
Narcissus jonquilla	Jardin du Palais Royal	237	225	219	
Narcissus poeticus	Jardin du Palais Royal	180	145	20	
The house by Sacre-Coeur	Rue du Mont Cenis	233	231	222	
Trees on the square	Rue Condorcet	73	61	52	
Steps of Eglise Saint-Vincent de Paul	Rue la Fayette	177	167	154	
Street lamp	Boulevard de Bonne Nouvelle	62	54	51	
Gates of Théâtre du Gymnase Marie Bell	Boulevard de Bonne Nouvelle	138	144	143	
Doors of Théâtre du Gymnase Marie Bell	Boulevard de Bonne Nouvelle	141	164	152	
Glove Shop	Jardins du Palais Royal	39	51	38	
Nadja's cafe	Quai Malaquais	72	76	79	
Sennelier	Quai Malaquais	29	59	57	
Bookshop	Rue de Seine	45	63	85	
Woodwork on square	Place Dauphine	125	118	118	
Woodwork on square	Place Dauphine	230	216	196	
Woodwork on square	Place Dauphine	54	96	112	
Woodwork on square	Place Dauphine	167	148	125	
Sacre-Coeur	Parvis du Sacre-Coeur	167	148	125	

Figure 29

Direct colour samples, Avec Nadja, (2017-2018)

23-24, March 2017

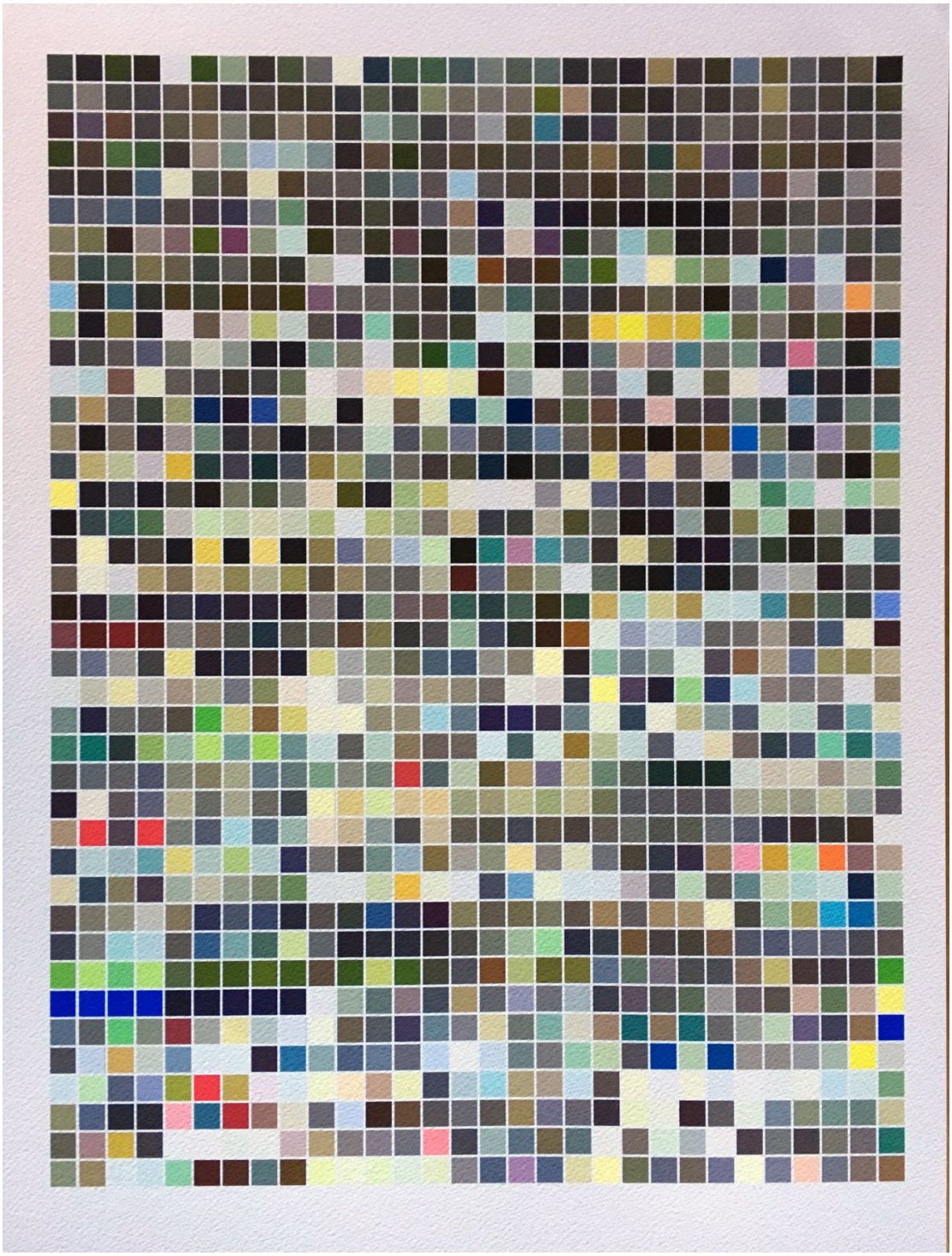


Figure 30

Avec Nadja, (2017-2018)

Indirect colour samples, 23 March 2017

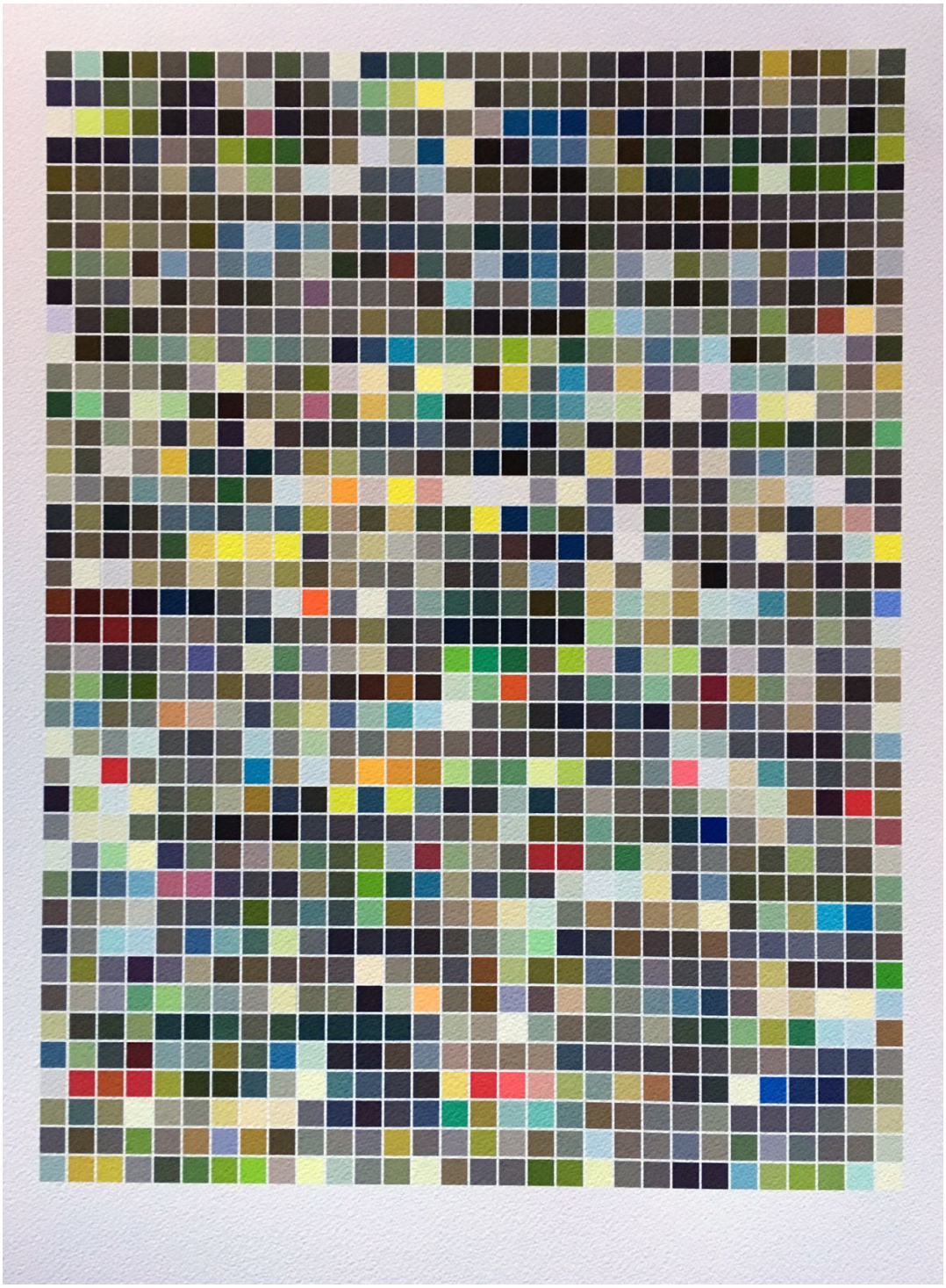


Figure 31

Avec Nadja, (2017-2018)

Indirect colour samples, 24 March 2017

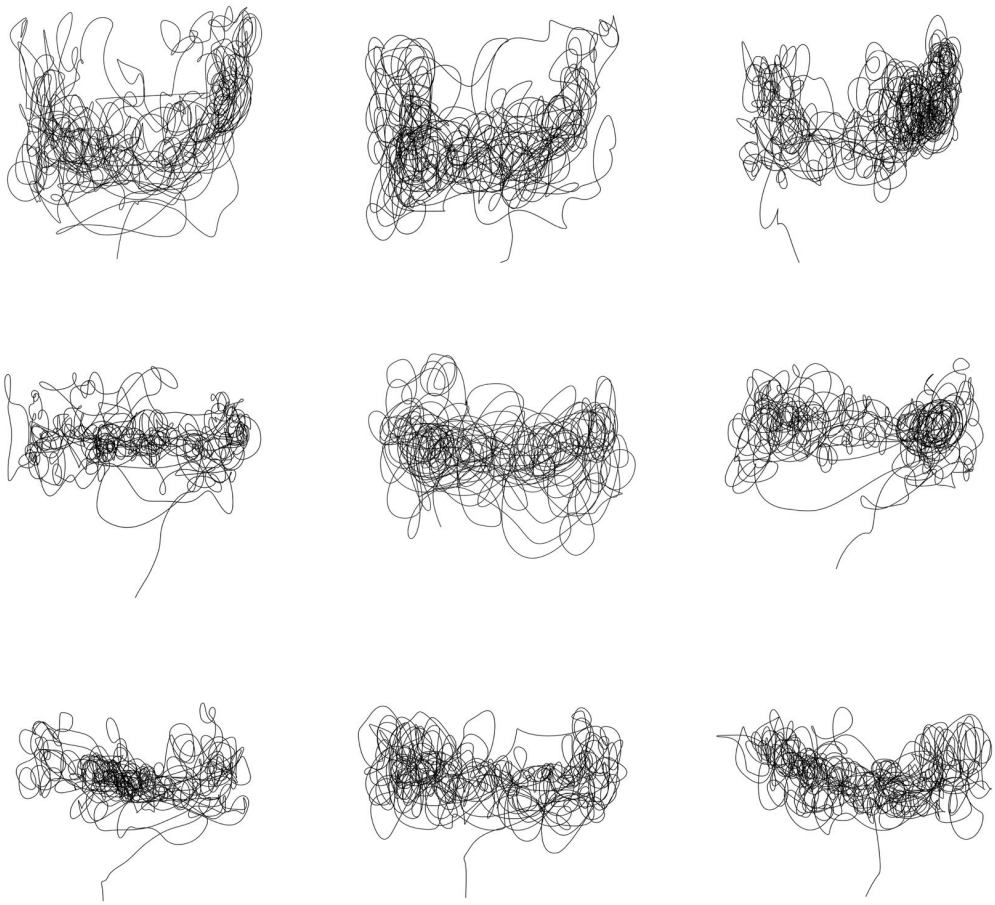


Figure 32

Rosa-Luxemburg-Platz

Trace drawings, (2013, 2014, 2015)

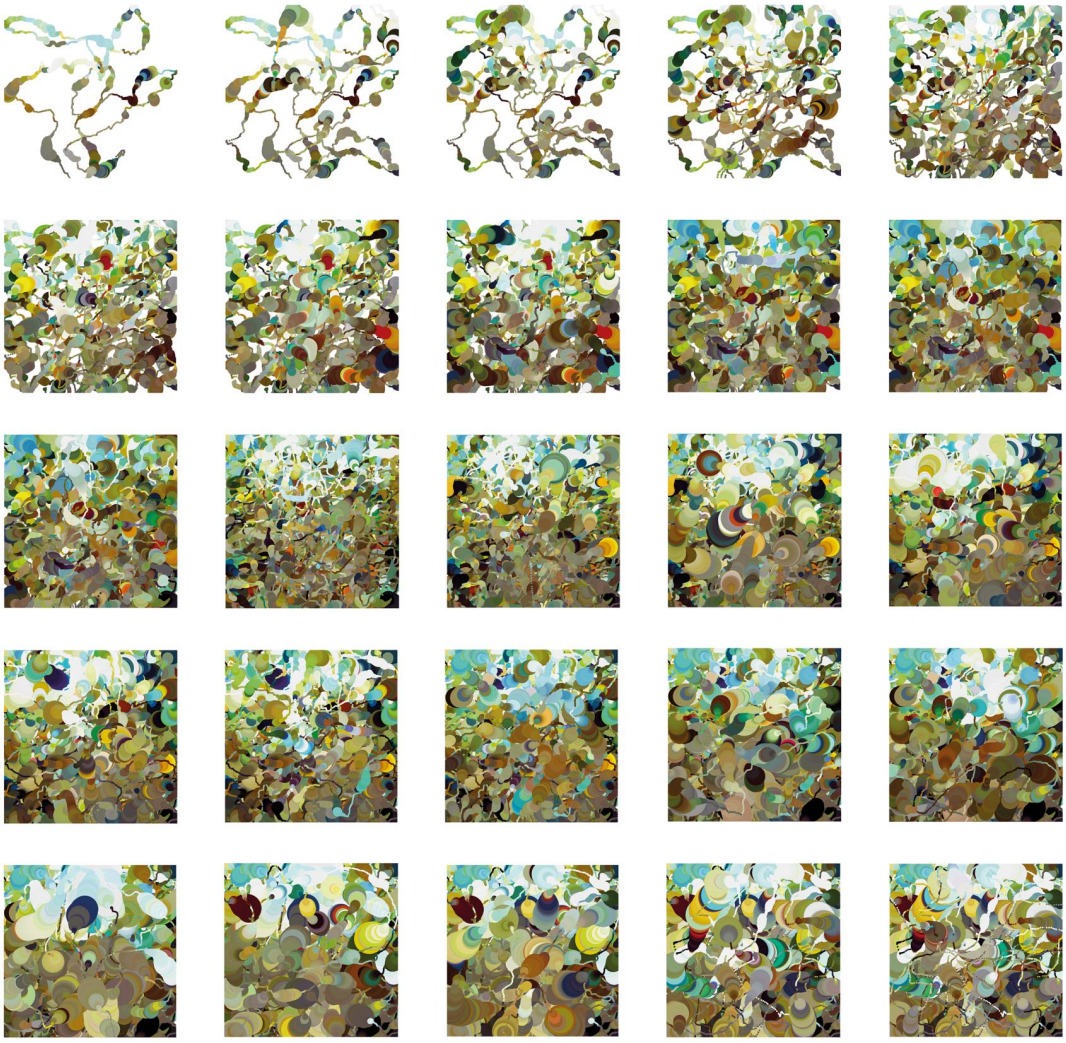


Figure 33

Avec Nadja, (2017-2018)

Indirect path samples, 23 March 2017

Figure 34

Avec Nadja, (2017-2018)

Indirect path samples, (detail), 23 March 2017

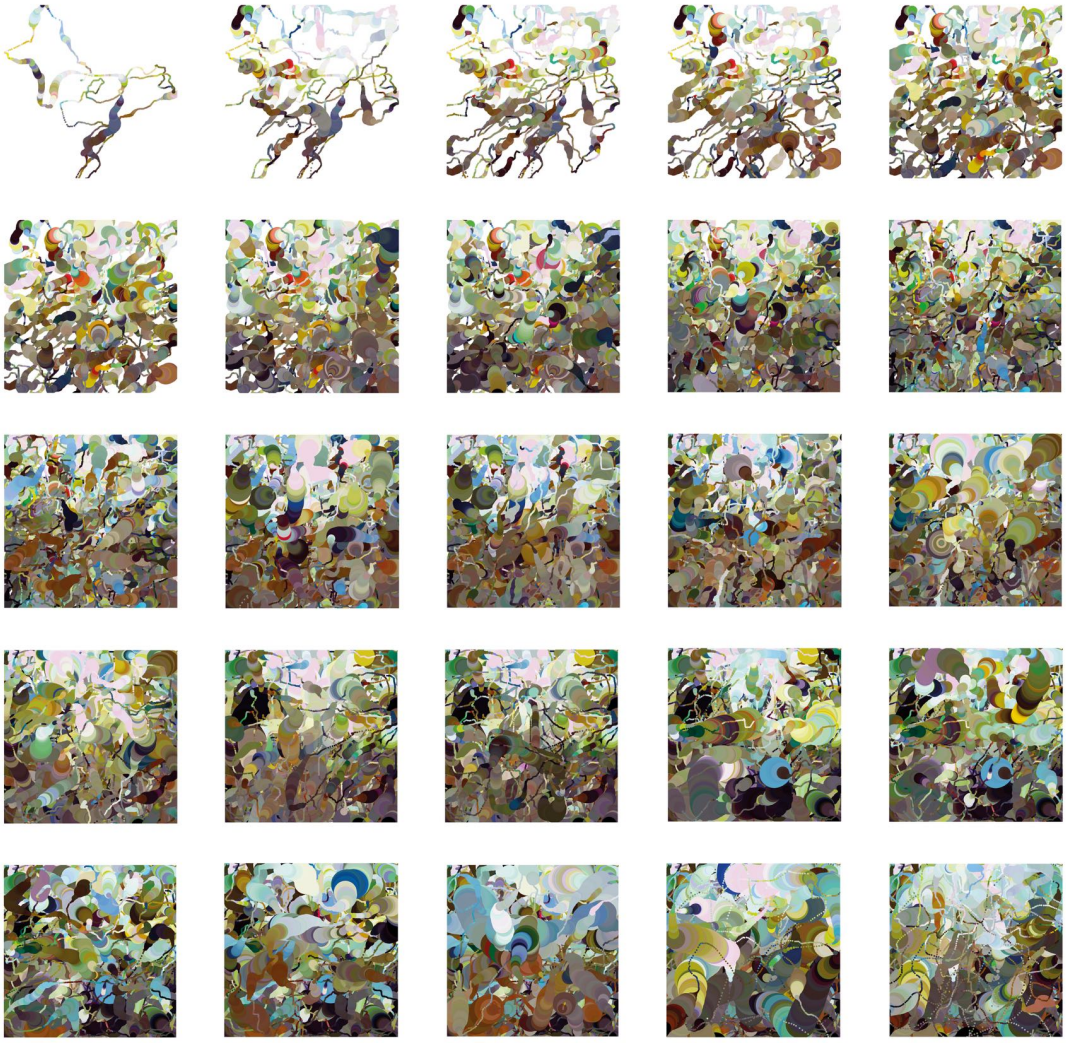


Figure 35

Avec Nadja, (2017-2018)

Indirect path samples, 24 March 2017

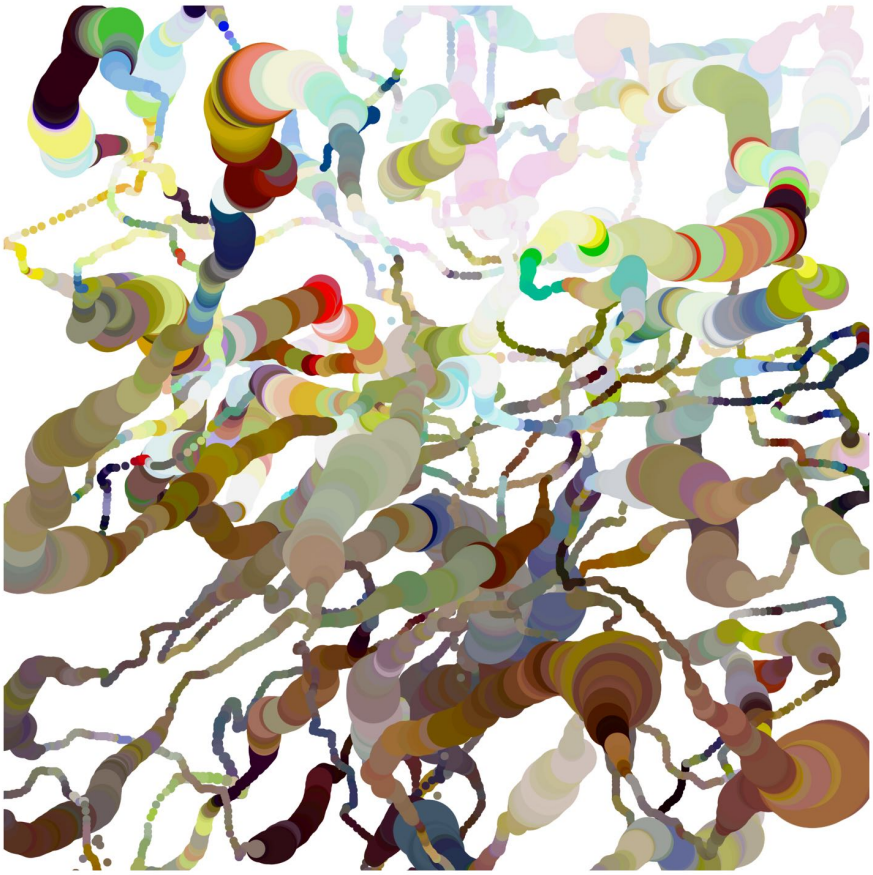


Figure 36

Avec Nadja, (2017-2018)

Indirect path samples, (detail), 24 March 2017

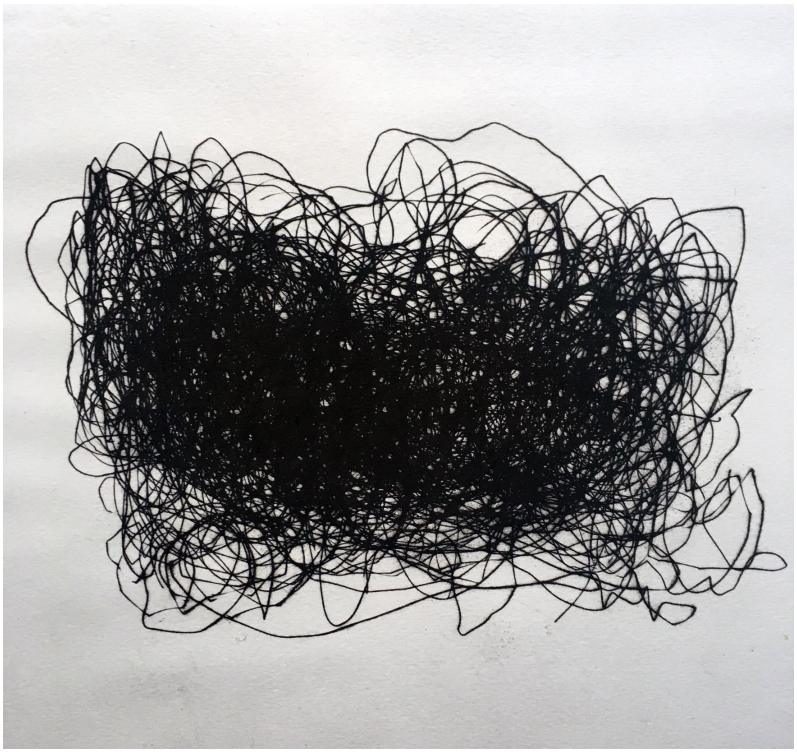


Figure 37

Avec Nadja, (2017-2018)

Traced path, 23 March 2017, Dry point etching on paper

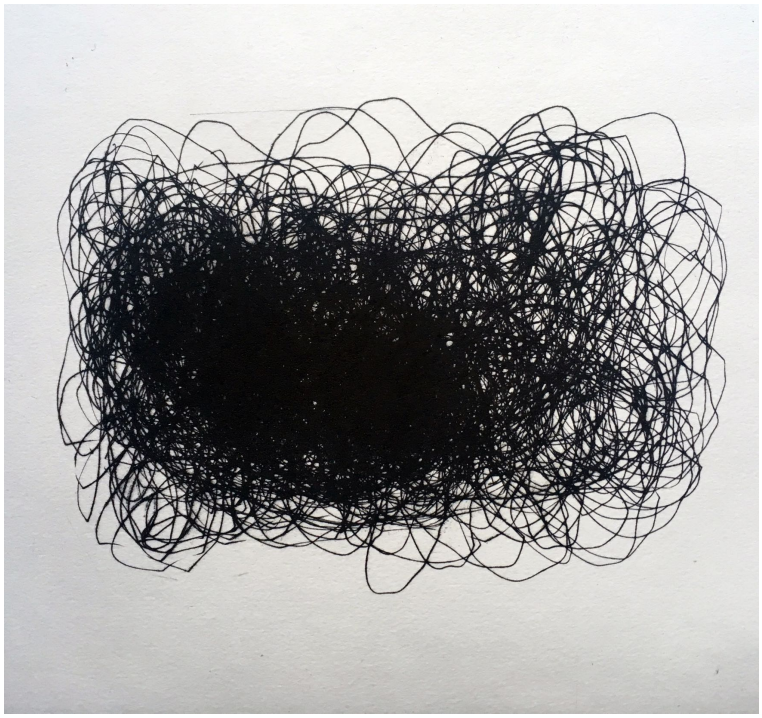


Figure 38

Avec Nadja, (2017-2018)

Traced path, 23 March 2017, Dry point etching on paper

Deconstructing the System

A typical system walk is now briefly deconstructed by employing some of the tools and metaphors that were introduced in Chapters 2 and 3, which relate to the Ecosystem, and Information Flow. There is an interesting interplay within systems between things that can be described in structural terms, and things that intersect and cut through these hierarchies, and this thinking has been drawn from Actor-Network theory, (ANT) and Assemblage Theory.

The distinction should be noted here between how something functions as a system, in terms of its internal structure, which can be described hierarchically, and how it operates in the wider world. For example, a body can be described in terms of cells, skeletal system and organs. Whereas different descriptive systems are required to describe the life of the body and the complex social interactions it performs. So, it is with an artwork, an artwork can be constructed from procedural rules, but its wider functionality as an artwork requires a different set of descriptive tools. The ecosystem model is a useful device as it describes the underlying structure, whilst allowing a broader overarching description of the work. It does however require the additional flexibility that ANT and Assemblage affords if the work is described in terms of its interaction with the wider social system.

The first useful idea is ‘Structural Resolution’, which organises things in terms of their structural complexity. At the most primal and basic levels are the morphological or affective processes, which structure the more complex operations at a primitive level. Thus, the way I breathe, move or hold a pencil could be described in these terms. Whilst cascading activities describe more complex, sets of primary activity where there is a chain of events, and the physical act of walking, for example, fits this category. Whereas, the more complex processes involved in the production of the outputs can be described by Process-response systems, such as the feedback operations in the paintings, or the Control systems that define the overarching rules of the system. See figure 39.

As the system walks can be understood as ecosystems there are some aspects that can be described in morphological or rule-based terms. The way colours are sampled or the way photographs are created are the production rules, and these in turn become one of a series of works, which more fully articulate the underlying system. Taken together the works, and the rules and actions that produced them can be understood

as the art system or ecosystem. These artworks have a dual or borderline status between an object and descriptive system, as they can be presented as a coherent artwork with multiple parts, but they are also mental constructs and the ecosystem description remains persuasive even if the parts are not exhibited together as an installation.

Category	**Description**	**System Category**
Society	Art as part of wider circulation of culture	Systems
Contemporary art	Practices as part of wider circulation of art	
Within a curated practice	Artwork as part of an exhibition	
Artist's wider practice	Rule-based work + System-based work	
Art System	System Walk	Objects
Series of art objects	Series of works, such as the Ghost photographs	
Discrete art object	Single works from series, such as a single photograph	
Control systems	The system rules employed in the production of work	
Process-responses systems	The feedback processes in the production of work	Processes
Cascading systems	More complex primary activity such as walking	
Morphological systems	Breathing, using a brush	

Figure 39

Structural breakdown of artwork

Moving further up the hierarchy an ecosystem, such as 'Avec Nadja' can be understood as being part of the wider practice of the artist. Whilst beyond the scale of the individual artist more complex and heterogeneous systems emerge that cannot be controlled or described by the artist. A curatorial practice, for example, is inevitably more complex in material and information exchange terms than a single artist, as they are temporally pulling together the work of different artists, or in Assemblage terms, reterritorialising the works, (and the underlying systems), to create new more complex systems. These in turn can collectively be described by the wider description of the Contemporary Art system. Wider still an overarching description of society and how art functions as only one aspect of culture is the most complex system description of how art operates.

By considering the artwork in this structural way we can see how we move from very precise descriptions of how something functions at the morphological level, to very broad speculative and invariably retrospective descriptions at the most complex level. Thus, on a morphological level I could monitor my breathing or blood sugar levels as I climbed Stac Pollaih, but I could not map this directly to the work produced from that walk. I could map the blood sugar levels, to the fluctuations in walking speed, but I could not describe how this contributed to my overall sense of the experience or 'lifeworld'. As even with a relatively simple system the relationship between things are non-linear, and what the system creates cannot be fully mapped to what the system absorbs.

This leads to a second organisational model, 'Community Scale', which can be applied to an individual practice. As it usefully demonstrates how individual works are part of the wider more complex community, which, taken together forms the overall practice (figure 40). The total practice is constructed from the sum of preceding work, and this totality represents the artists' system to describe their world. This emergent model becomes into view over time, as the practice is assembled and relationships and dialogues between works appear. Some artists are doing this at a conscious level and articulating this through the rules and ideas they employ to make their work, whilst other artists are having these descriptions imposed upon their body of work, in retrospect, through the external and top-down mechanics of art history and criticism.

Hierarchy	**Description of relationships**
Total Practice	Total Practice of artist, or 'Macro-scale ecosystem'
Related Ecosystems	Related Ecosystems, or 'Meso-scale ecosystem'
Ecosystems	A defined ecosystem that encompasses lower level systems
Functional groups of art objects	Sets of interacting populations that could form an ecosystem
Related series of art objects	Similar populations generated from rule-based systems
Series of art objects	Population generated from a rule-based system
Individual art object	Individual outputs of a rule-based system

Figure 40

Community Scale

Thus, on the level of the individual art object I will be aware of the processes employed in its production and these works will exhibit emergent qualities, (and upward

causality), as the rules or the environmental plasticity will generate unexpected results. When these individual art objects are part of more complex system the overarching system cannot be described solely through the rules applied in the production of the work. Thus, they can only be fully described in downward causation, descriptive system terms, as an ecosystem.

It should be noted in this hierarchy that the categories and things contained within the categories are to some degree mental constructs, such as the distinct ‘object', or painting. This is not to say there is not an object or a painting, but rather the attribution of objectness is subjective. As Manning argues, for something to be defined as an ‘object', in this case, something within a descriptive system of interacting things ‘the "object" has ‘to be conceived as out of time, relegated beyond experience' (Grusin, 2015, p. 46). I find it interesting that the upward and downward causal descriptions are logically consistent in their descriptions of the subject, but they are not necessarily consistent with each other. Likewise, as a work increases in complexity the ecosystem model requires the additional functionality that ANT brings so that relationships can be articulated that cut through the neat hierarchical structures presented here.

Thus, in upward terms I am fully aware of my formal processes, which are experiments in decisions, pattern and colour, and I derive great satisfaction from seeing the paintings emerge from these processes. I also acknowledge in downward descriptive terms, that my work fits within the wider Systems art history, and in particular, it directly draws from the process of walking in art and the formal systems painters that employed rules and the action painters that employed material control. This understanding of my practice can be described as an ‘a posteriori’ description of my practice as this has emerged in the process of this research. In particular I am sometimes surprised by the emergent system, and the ideas they reveal. As they reveal things that I was unaware of, at least at a conscious level when the project started with a simple walk and set of rules.

The system walks can also be understood in terms of information flow and this helps highlight the different information sources and categories of information that are flowing through the work. For example, for ‘Avec Nadja’ this would include things that are not immediately obvious from the system outputs. Such as Nadja the book, or my own relationship to Paris and the work of Breton, and how this influenced my feeling for what I experienced on the walks, and the paths taken through the city. Thus, during the production of the walk different information can be seen as inputs into the system.

Some of these are quite direct affective first-hand experiences, such as the experience of the walk. Whereas others are more mediated forms of information, such as the expressed ideas in the book, or the rules employed in the production of the walk. Then in the studio I have an affective and enacted relationship with the materials and information in the production of the work.

Some of the works generated, such as the direct samples of colour clearly show the mark of the underlying rules, with clean grid systems of colour fields and the compulsion to repeat, but they also contain traces of the original uncanny experience of their informational source from wandering through the streets. As Morton notes,

> Repetition and automation apply to the creation of spaces.. Think of a grid pattern of streets: functional, efficient, and easy to produce. A grid involves repetition in at least two dimensions..(and) you will inevitably encounter repetition in the modern city. You will inevitably experience the uncanny. The uncanny is a function of repetition, because it brings to light our compulsion to repeat, a feature of our psyche. ..Modern life multiplies these uncanny experiences. (Morton, 2012, pp. 53–54)

Thus, it can be said that the totality of an artist's practice operates as a system and offers up their provisional model of the world. Whilst on a specific art object level rules are employed to generate, for example, a painting, but the rules are not necessarily being derived directly from the world; rather they are incomplete ways of describing the world. They are provisional models. Thus, the rules I employ to produce a rule-based painting are insufficient to describe the completed paintings. Rather the rules can be found in the paintings, but the works themselves are far more complex, and the full nature of the painting is essentially 'withdrawn', hidden from view, uncanny and irreducible to mathematical description. Thus, in a sense, the art objects are a more effective carrier of information describing the System or model of the world, than a written description of the system. The fundamental reason is that the ecosystem contains space in which the art experiences takes place, and the artist cannot formalize these operations in systems terms due to the complexity of the system. Thus, the concept of the ecosystem needs a greater level of flexibility if it is to give a full description of the artwork, and this is demonstrated in the following examples of 'disruptive systems', which are returned to in chapters 5 and 6.

Disruptive Systems

These are works that are not neatly explained by the application of rules or the ecosystem description, and point to a future unfolding of my art practice and understanding of systems.

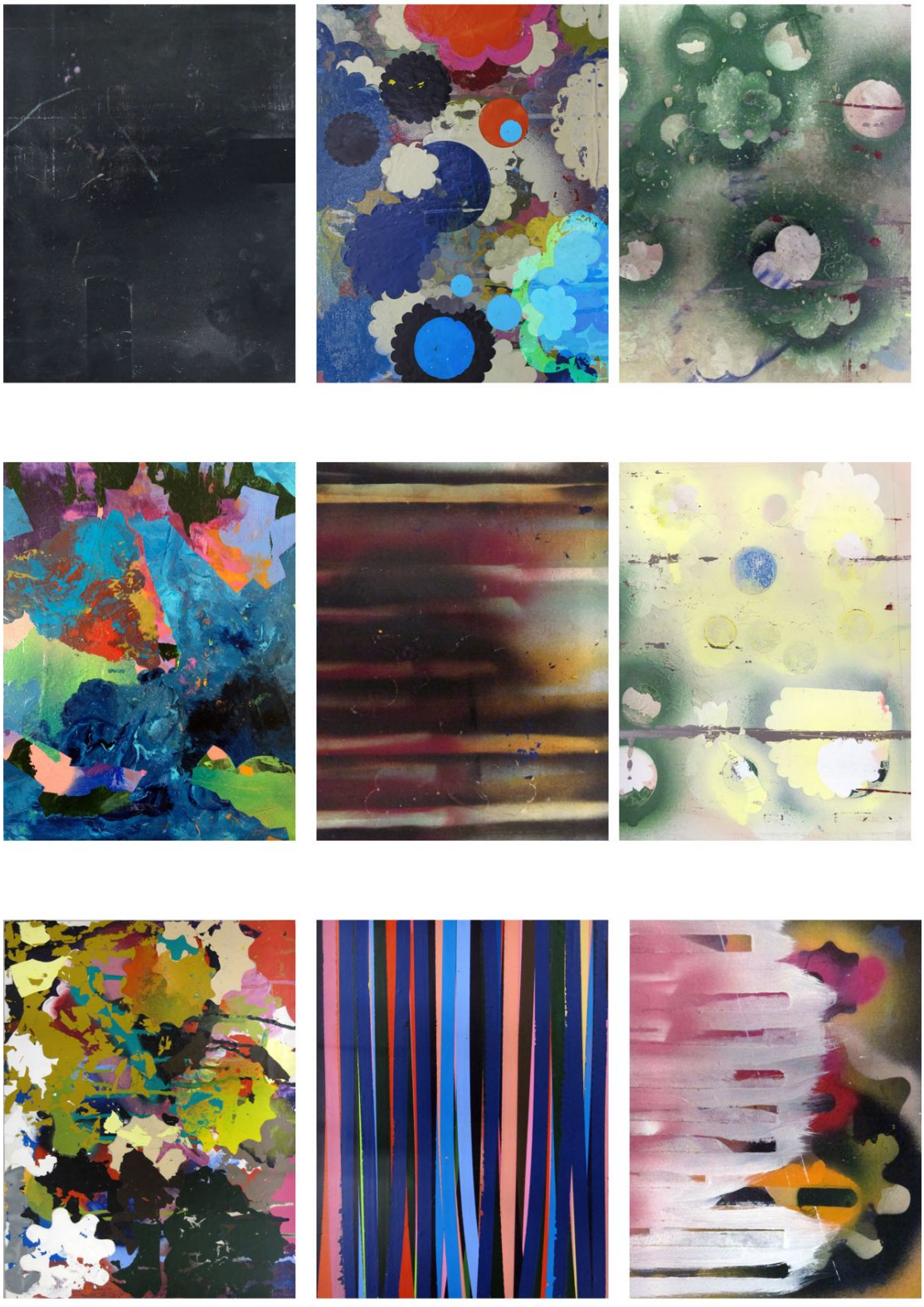


Figure 41

Disruptive paintings, 2016-2017

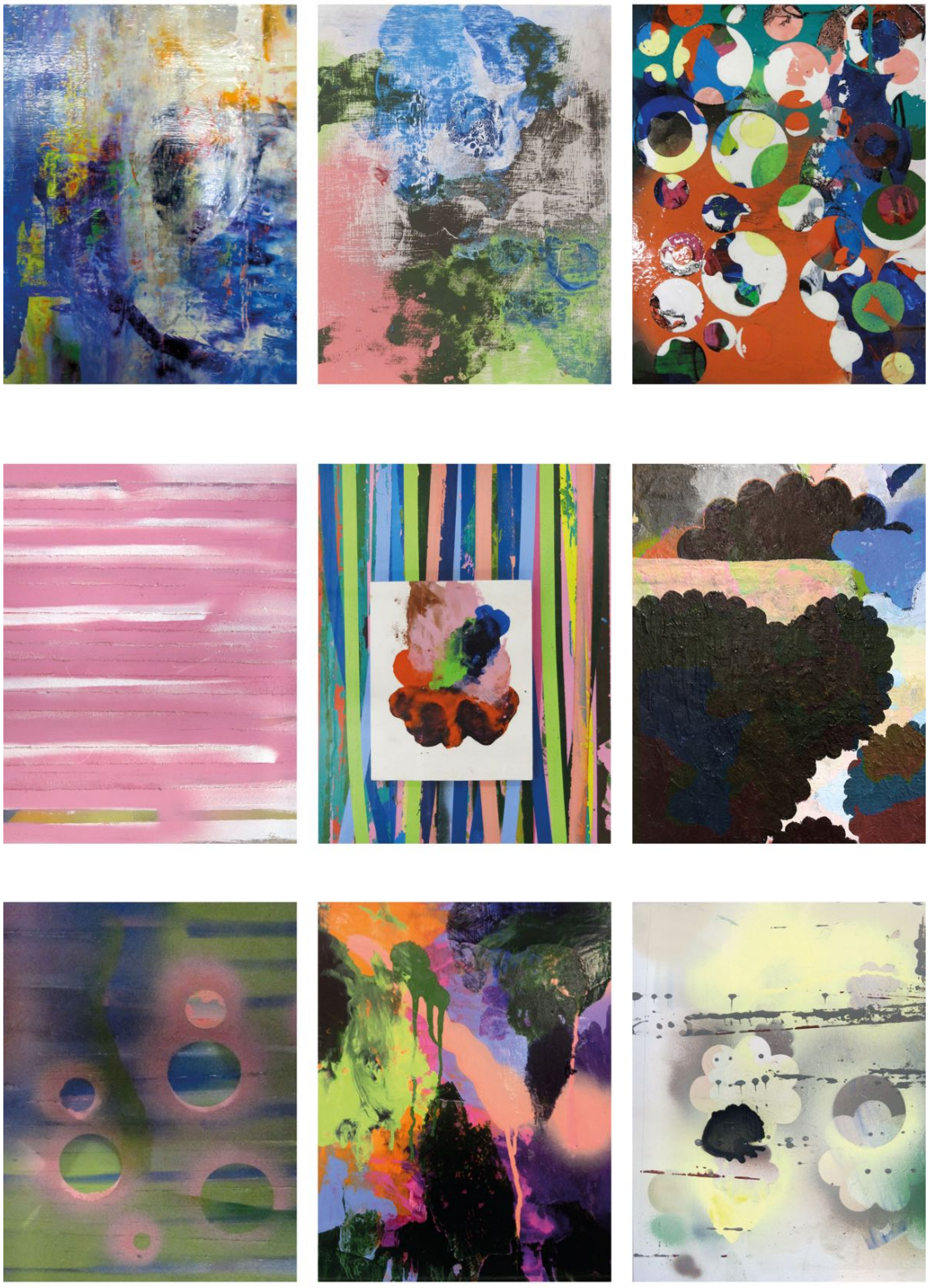


Figure 42

Disruptive paintings, 2016-2017

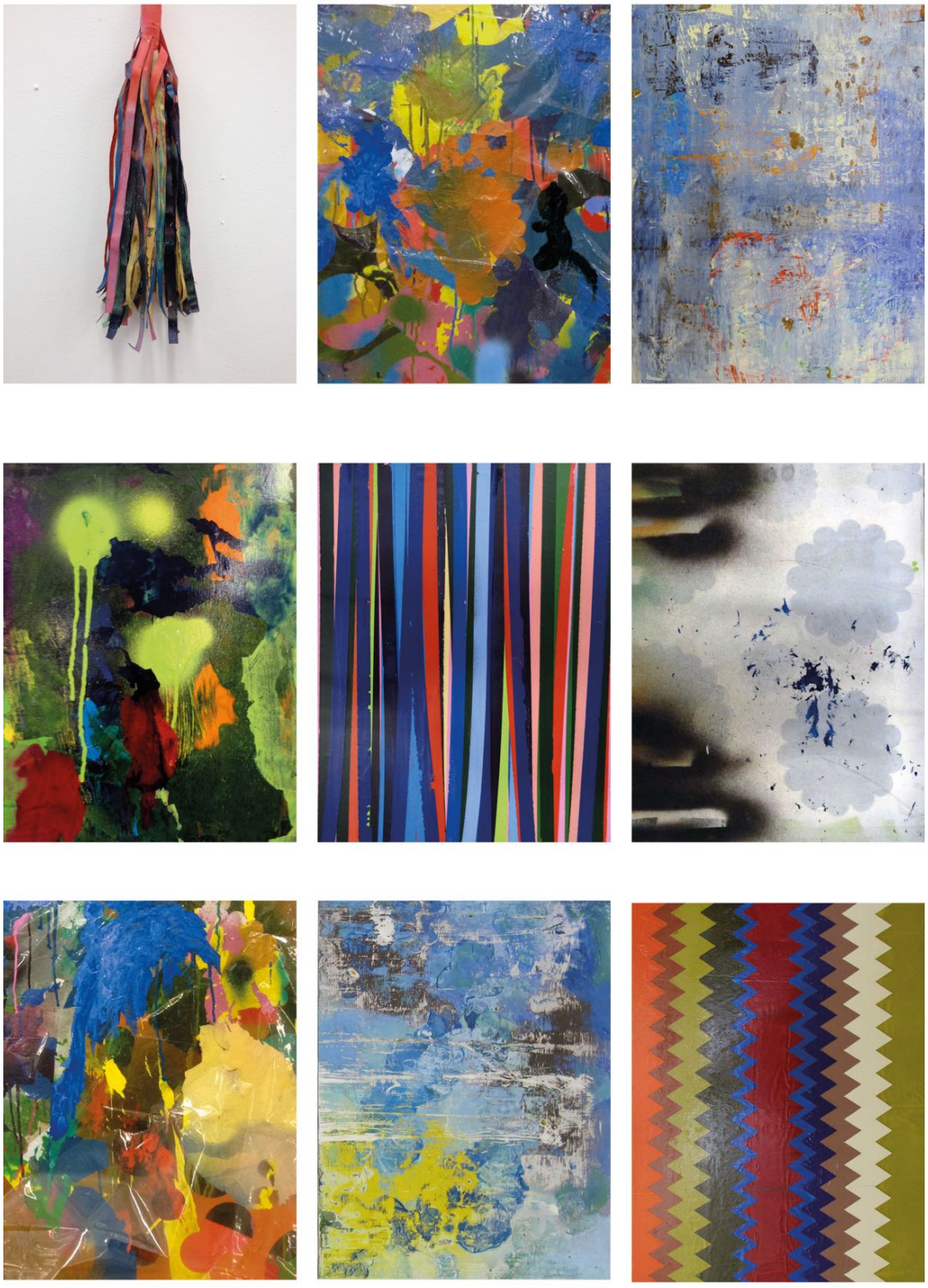


Figure 43

Disruptive paintings, 2016-2017

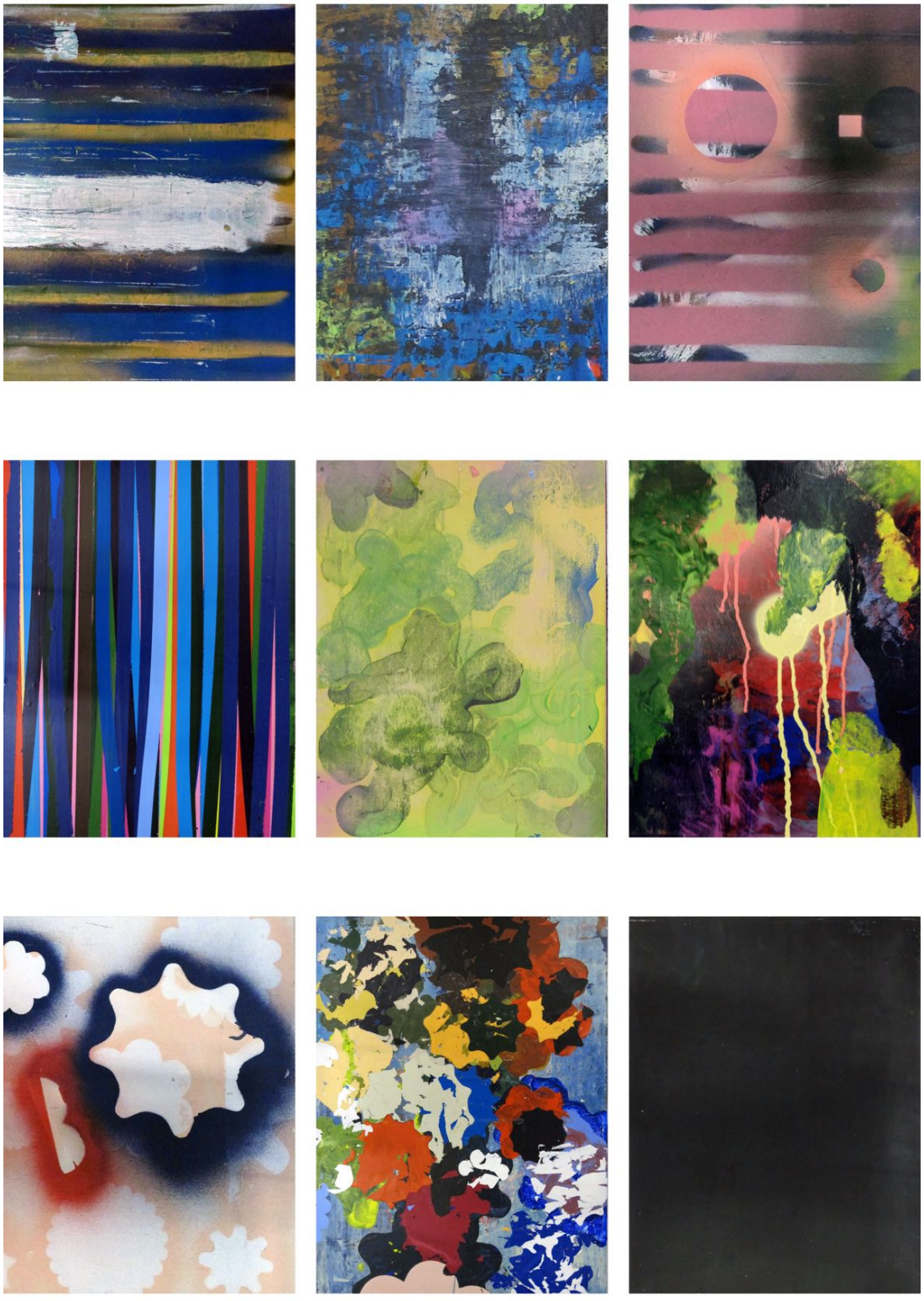


Figure 44

Disruptive paintings, 2016-2017

Figure 45

Disruptive painting, 2016

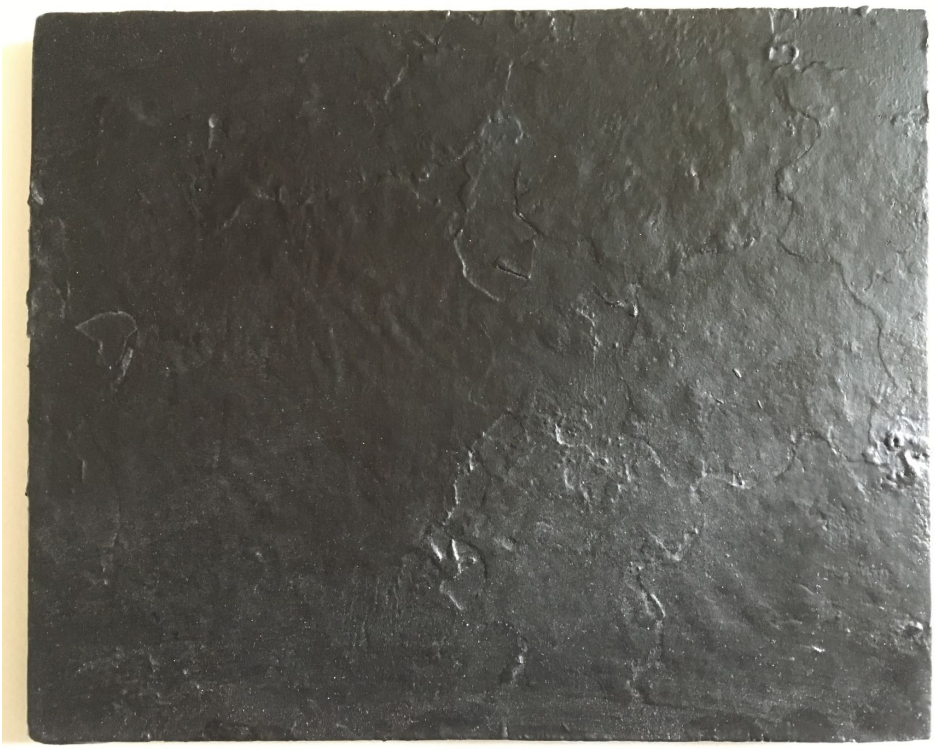


Figure 46

Disruptive painting, 2016

Black Noise, 001

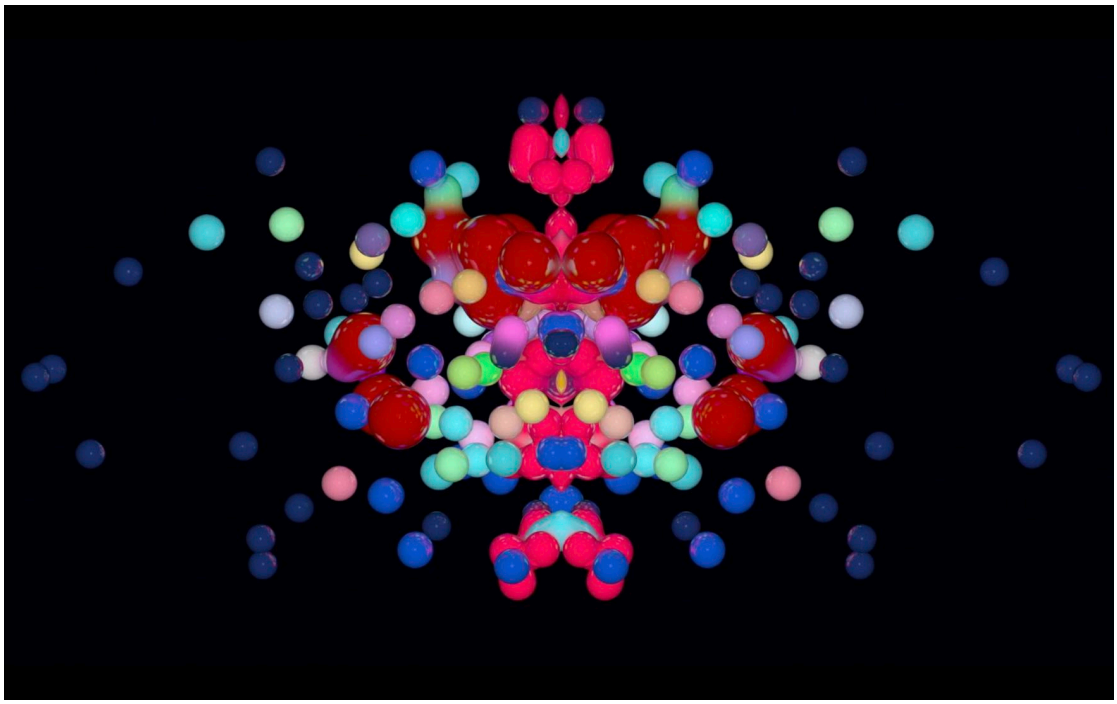


Figure 47

Remotely sensed, (detail), 2014-2018

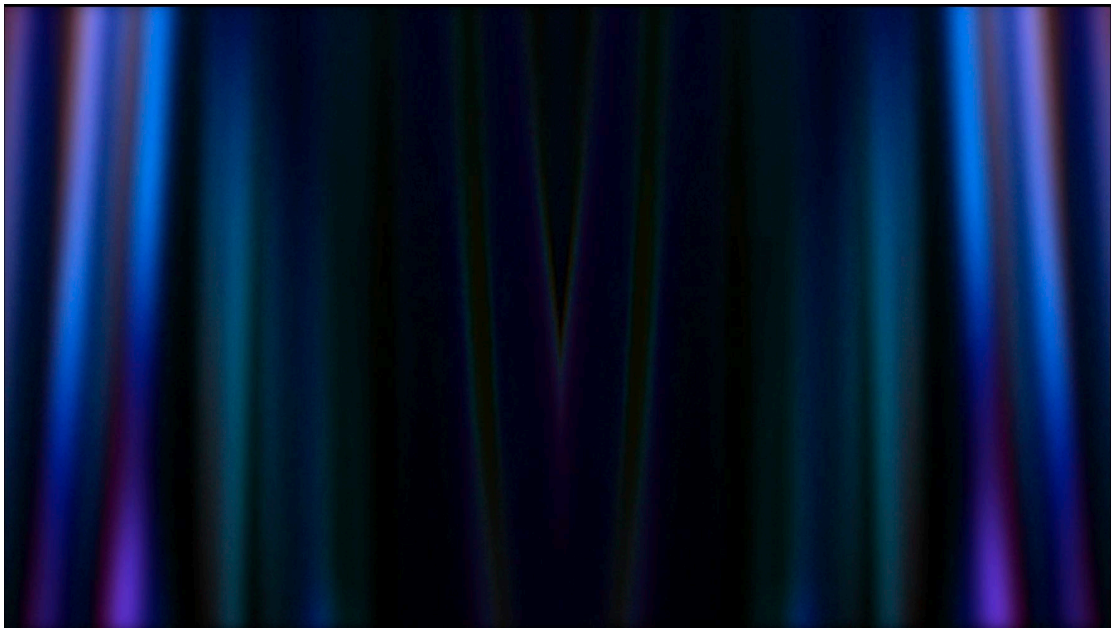


Figure 48

Remotely sensed, (detail), 2014-2018

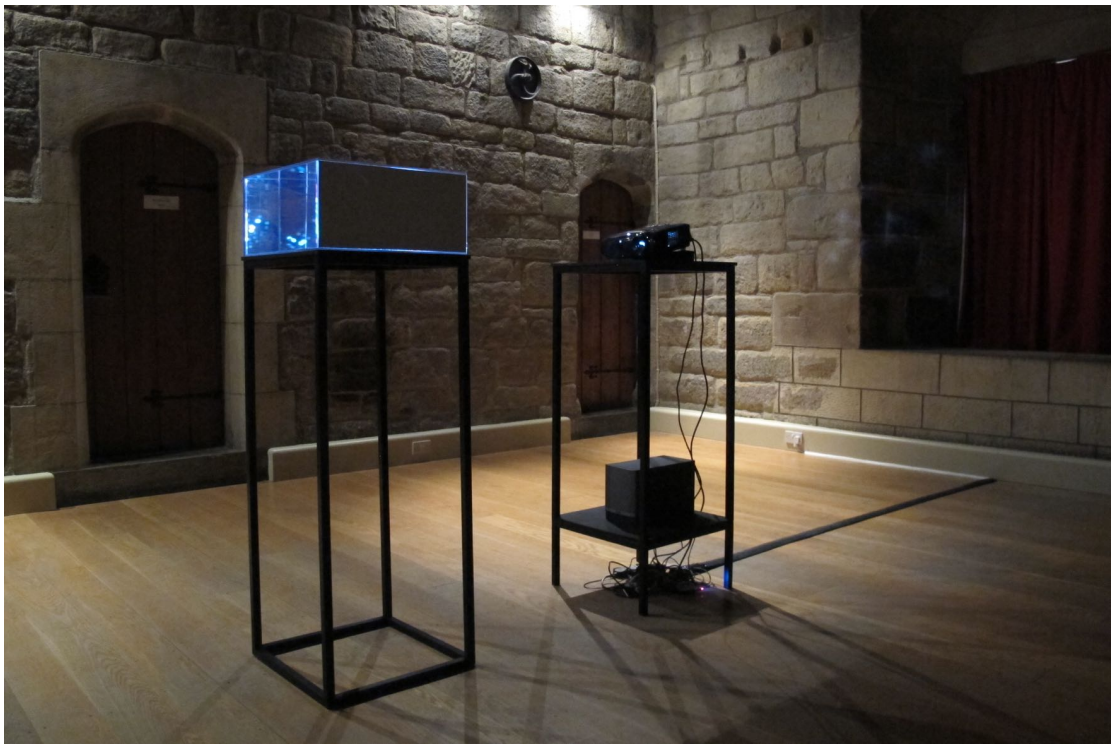


Figure 49

Remotely sensed, (detail), 2014-2018

Installation view

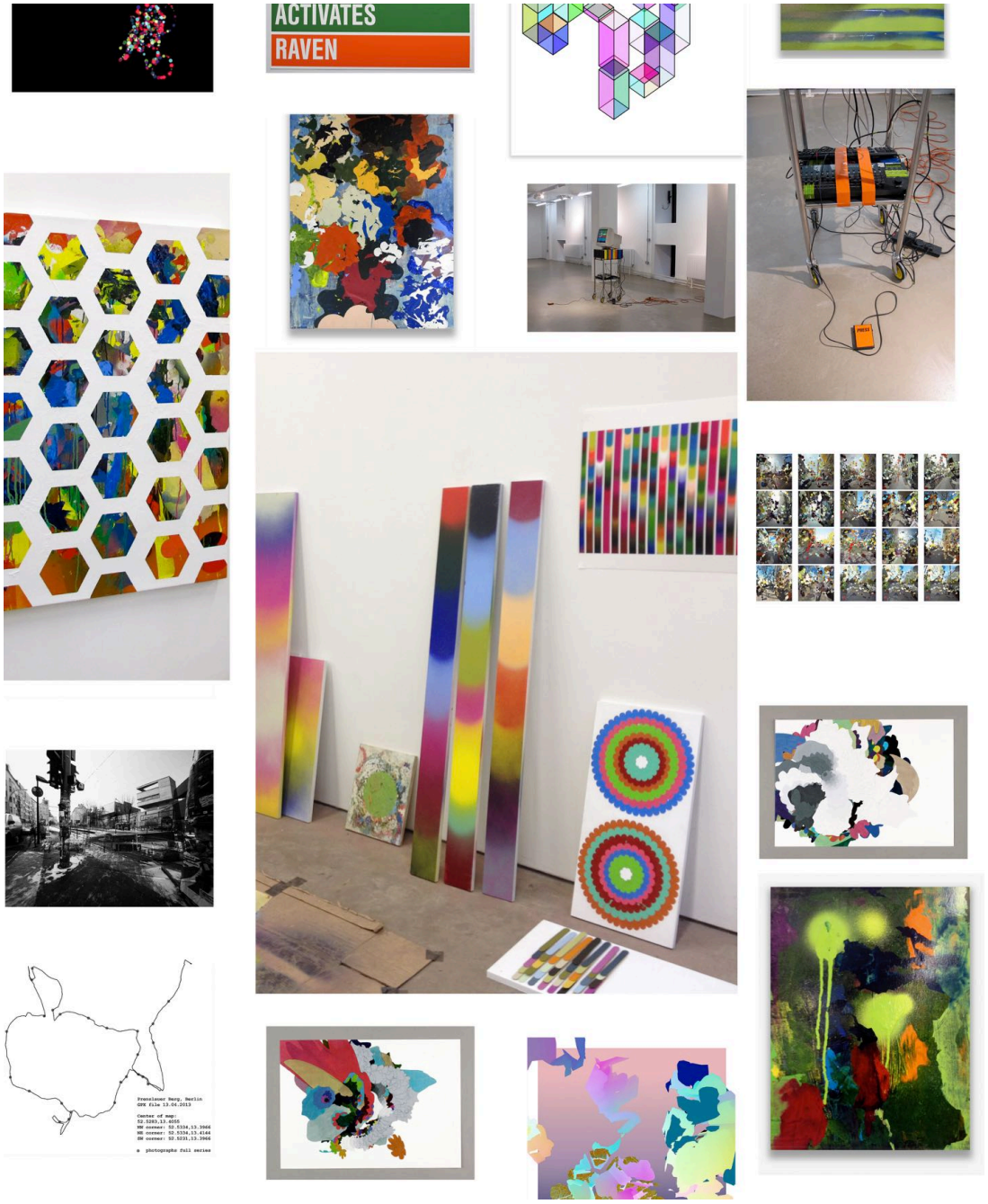


Figure 50

Screengrab of the website www.systemcoredump.com

The website ‘systemcoredump’ was a visual record of my studio practice during the PhD research

Figure 51

Installation view of Viva exhibition: The Distributed Ecosystem

Northern Dance, Newcastle, March, 2018

References for Appendix 3

Bateson, G. (1980). *Mind and Nature* (New edition edition). London: HarperCollins Distribution Services.

Bateson, G. (2000). *Steps to an Ecology of Mind.* University of Chicago Press.

Barragán, P. (2007). *THE ADVENT OF EXPANDED PAINTING*. Retrieved 5 August 2017, from http://www.cottelston.com/mashmiami_pop_essay.html)

Fares, G. (2004). *Painting in the Expanded Field. Janus Head*, *7*(2), 477–487.

Fogle, D. (Ed.). (2001). *Painting at the Edge of the World*. Minneapolis: Walker Art Centre,U.S.

Galenson, D. W. (2002). *Painting Outside the Lines: Patterns of Creativity in Modern Art*. Cambridge, Mass: Harvard University Press.

Gregg, M., & Seigworth, G. J. (Eds.). (2010). *The Affect Theory Reader*. Durham, NC: Duke University Press Books.

Grusin, R. (Ed.). (2015). *The Nonhuman Turn*. Minneapolis: University of Minnesota Press.

Harris, J. (Ed.). (2003). *Critical Perspectives on Contemporary Painting: Hybridity, Hegemony, Historicism*. Liverpool: Liverpool University Press.

Ingold, T. (2016). *Lines* (1 edition). London ; New York: Routledge.

Jameson, F. (2009). *The Cultural Turn: Selected Writings on the Postmodern, 1983-1998*. Verso.

Joseph, B. W. (2007). *Random Order: Robert Rauschenberg and the Neo-Avent-Garde* (New Ed edition). Cambridge, Mass.: MIT Press.

Krauss, R. (1979). *Sculpture in the Expanded Field*. *October, 8*, 31-44.

doi:10.2307/778224

Lennon, T. M. (2007). Proust and the Phenomenology of Memory. *Philosophy and Literature*, *31*(1), 52–66. https://doi.org/10.1353/phl.2007.0010

Meltzer, E. (2013). *Systems We Have Loved: Conceptual Art, Affect, and the Antihumanist Turn*. Chicago ; London: University of Chicago Press.

Morris, R. (1995a). *Continuous Project Altered Daily: The Writings of Robert Morris* (New edition edition). Cambridge, Mass.: MIT Press.

Morris, R. (1995b). *Continuous Project Altered Daily: The Writings of Robert Morris* (New edition edition). Cambridge, Mass.: MIT Press.

Morton, T. (2012). *Ecological Thought* (Reprint edition). Cambridge, Mass.; London: Harvard University Press.

Myers, T. (Ed.). (2011). *Painting*. London : Cambridge, Mass: Whitechapel Art Gallery.

Petersen, A. ring. (2010). *Contemporary Painting in Context*.

Shanken, E. A. (2015). *Systems*. Cambridge, Massachusetts: MIT Press.

Van Den Boogaard, O. (2014, January 3). In search of Stanley Brouwn, (161). Retrieved from https://frieze.com/article/search-stanley-brouwn